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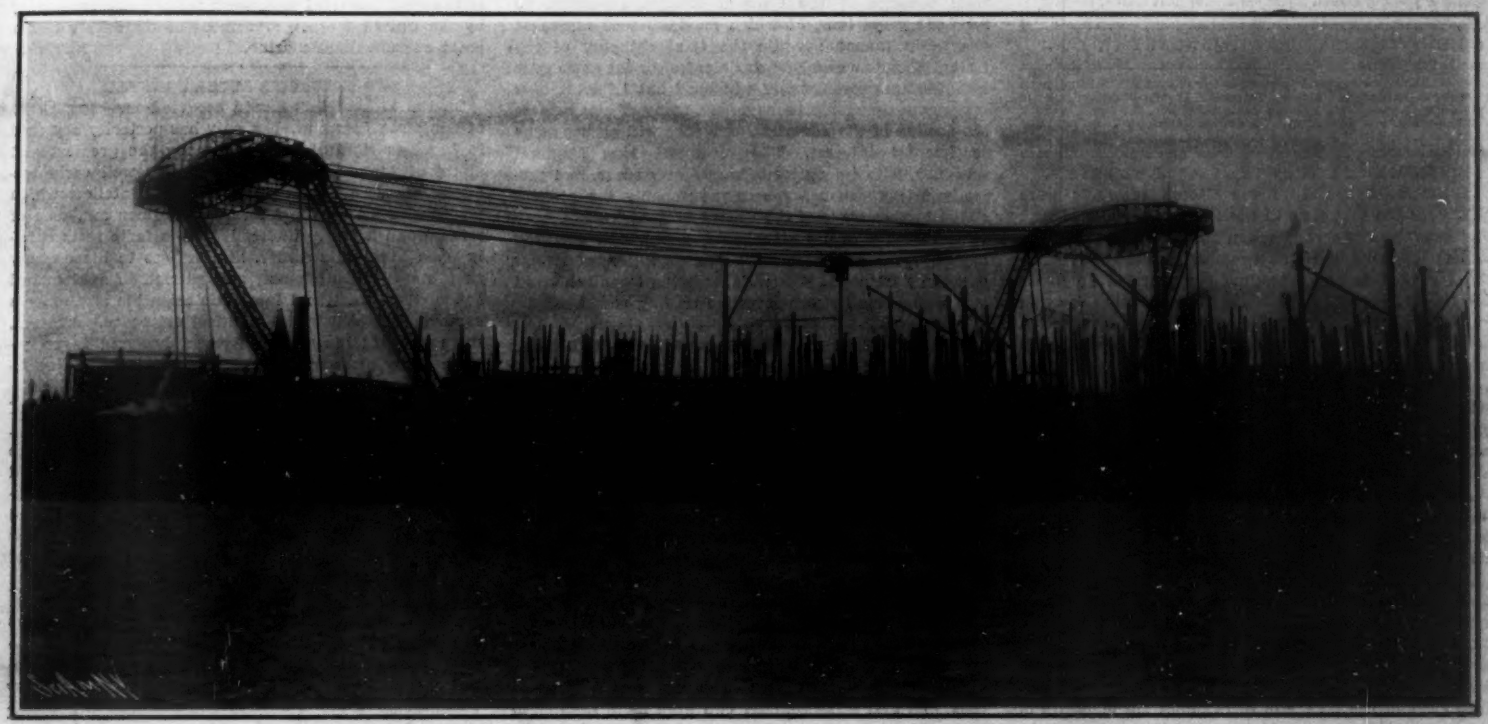

The Overhead Gear, Broadside View. The Design of the Overhanging Ends is Well Shown.

The Overhead Traveling and Hoisting Gear. The 16,500-Ton Battleship "Lord Nelson" in Course of Construction is Shown Below.

A NEW OVERHEAD TRAVELING GEAR FOR EXPEDITIOUS CONSTRUCTION IN SHIPYARDS.—[See page 90.]

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ESTABLISHED 1845

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NEW YORK, SATURDAY, JANUARY 27, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

FINAL COMPLETION OF THE CROTON RESERVOIR.

Although the gates of the Croton reservoir were closed for the first time in the spring of last year, and that event was generally taken as marking the completion of the great work, as a matter of fact the crest of the dam had not at that time been carried up to its full height, nor had anything been done on the erection of the fine arched span, which now forms a connection between the crest of the main dam and the rocky bluffs which form one wall of the spillway. During the intervening months, the great mass of masonry which constitutes the dam proper has been carried up to its full height, and the broad roadway has been completed across its crest from the northerly to the southerly abutment. The crest of the spillway was the last portion of the stonework to be completed to its full height, and on January 17 of this year the Comptroller of the city of New York, as representative of the Mayor, laid the last stone, thus putting the great wall of masonry in position to hold the waters of the impounded lake up to the high-level mark which represents the reservoir's capacity of about 30 billion gallons of water. In our issue of April 15, 1905, we gave a complete series of views of this noble work, including some of the steel bridges which carry the new driveway over various arms of the lake, and form important elements of the splendid driveway which runs entirely around the reservoir.

Quite apart from its priceless value as forming the most important element in the water supply of the capital city of the New World, the Croton reservoir is destined to become, in future years, one of the most picturesque sections of the magnificent system of boulevards and driveways which extends from Riverside Drive and Lafayette Boulevard up the easterly bank of the Hudson River. With the construction of the Hudson Memorial Bridge, and the improvements in grading and in surface which are bound to take place on the Albany Post Road, there will be no finer automobile trip in the State, both for the picturesque beauty of the country and the wide variety of interest, than a run to the Croton reservoir by way of the Hudson, and a trip over the splendid roads around the lower portion of this lovely artificial lake.

SHIPBUILDING IN THE UNITED STATES.

Were it not for the orders obtained by our shipbuilding yards for the construction of United States warships, and other government vessels such as revenue cutters and lighthouse tenders, it would be difficult for many of these establishments to keep their costly plants in operation. This is particularly true of the larger plants located on the Atlantic and Pacific seaboard. Thus we find that during the fiscal year ending July 1, 1905, there were under construction or under contract in the shipyards of the United States seventy-six steel merchant vessels, of 190,903 tons, and thirty-nine steel government vessels, of 308,702 tons; so that the amount of work being done for the government (most of it for the United States navy) was over sixty per cent greater than the work being done for private shipping concerns. Even more remarkable were the conditions in 1904, when the merchant tonnage was only 94,988 tons, as against 331,435 tons that were under construction for the government. In the presence of these figures, it would be well for those people who are bitterly opposed to the upbuilding of our navy to bear in mind that our warships not only serve as guardians of the peace (for which they are just as essential as the police of our cities) but the very act of their creation has served to keep alive the important shipbuilding interests of this country. Indeed, the absolute cessation of new naval construction would involve the closing down of several of our building yards.

The merchant marine of the United States, including all kinds of documented shipping, comprised on July 1, 1905, 24,681 vessels, of 6,456,543 tons. About one-half of this amount was afloat on the Atlantic and Gulf coasts, one-third of it on the Great Lakes, while on the Pacific coast the total amounted to 792,088 tons, the small remainder being found at the Hawaiian Islands and on the western rivers of the United States. During the year, 1,102 vessels of all kinds, great and small, were built, the total tonnage amounting to 330,316 tons. Of this total, 40,000 tons consisted of steel steamers, including the big "Dakota" of over 20,000 tons; 14,149 tons consisted of steel ferry, river, and bay steamers; and 29,104 tons of wooden schooners; while the importance of the Great Lakes shipbuilding interests is shown by the fact that the total tonnage of new steel steamers built there during the same year was 101,521 tons. Comparing the total gross tonnage of the American merchant marine, as given above, with that of our most formidable competitors, we find that for 1905 the total tonnage of the German Empire amounted to 3,517,673 gross tons, of which 2,888,693 tons represent steamship tonnage; while the total shipping of the United Kingdom and British Colonies for the same year is 17,900,720 gross tons, of which all but 1,600,182 tons represents steamship tonnage. In many of our readers the decline of the American schooner will arouse some sentimental interest. The far-famed New England schooner, with its generous beam, lofty spars, and perfectly fitting canvas, was unquestionably the pioneer of the foreign trade of the United States. To-day, however, in spite of its stanchness, speed, and carrying capacity, the schooner, with the exception of a few ports in Africa and Australia, is being steadily driven out by the small steam-propelled trading vessel.

ARMY TRANSPORT AND THE MERCHANT MARINE.

Speaking of the shipbuilding of the United States, we are reminded that the great importance of the possession by the United States of an adequate merchant marine, because of its bearing on the question of army transportation over seas, was strongly brought out in a report which has just been compiled by the General Staff, and forwarded through Secretary Taft to the chairman of the Joint Committee on Merchant Marine. The General Staff is remarkably frank in its discussion of the transport service in the Spanish war. We are told, regarding the Santiago expedition of 1898, that the Quartermaster's Department chartered every American vessel that could be obtained in the Atlantic ports in the twenty days following the declaration of war, and that as the grand result of its efforts it obtained only thirty-six vessels of an average size of 2,500 gross tons, and that of these, only two were more than 4,000 tons. The report proceeds to say (we trust that Congress will lay the words to heart): "The official records afford ample evidence that the safe arrival was due to the good fortune of continued fine weather. A severe storm would have scattered the fleet, probably with great loss of life, and would have defeated the object of the expedition. This fleet of ships could not have embarked, under reasonable conditions, a force of more than 8,000 or 10,000 men, and when so embarked, the expedition could have been dispatched on a long voyage only at great jeopardy of the welfare of the men, and of the success of the enterprise."

It will be remembered that following the close of the Spanish war a considerable increase was made in our enlisted army; yet because of the smallness of our merchant marine, we are not to-day in a position to utilize this increased force in any adequate degree, at a distance from our own shores. According to the General Staff, it is a fact that now, and for some time to come, the force for which our military establishment is maintained cannot be exerted over seas. The first quick blow, so increasingly important, cannot be struck at all, nor can an expedition of any great size be embarked without delay, except by the use of foreign vessels. This condition of things cannot improve until the American seagoing merchant marine has increased in tonnage to approximately two and a half times its present volume. Moreover, the ships should be adapted in size and in design to quick conversion into suitable transports, and should be built under conditions which make their voluntary surrender to the United States, on demand, a foregone conclusion. We are informed that a single army unit such as a division with nine infantry regiments, one cavalry regiment, three artillery battalions, one engineer battalion, and one company signal corps, with the necessary hospital, ammunition, and supply wagons, would require for its transportation ten 6,500-ton ships and nine 5,500-ton ships. Two such divisions, representing, say, 25,000 men, could be provided with transportation in fifteen days, and they would require twenty of the larger and eighteen of the smaller ships.

But owing to the fact that these merchant ships, built under transport requirements, might at the occurrence of a crisis be more or less widely scattered, and because of other delays, such as extensive dockyard repairs, it is not possible to reckon that more than one-third of the vessels required could be made available in fifteen days. Hence, for every ship for which there is likely to be a call, there must be three afloat. That is to say, to be certain of transporting our little army of 25,000 men, there should be afloat in our merchant marine sixty of the 6,500-ton ships and fifty-four of those of 5,500 tons. Furthermore, since the crisis might arise either on the Pacific or the Atlantic, it would be necessary to have this number of ships, suitable for transport, afloat on each ocean, or a total of 228 vessels of a gross tonnage of 1,368,000 tons.

Now, in 1904, in the whole American steam merchant marine, there were only fifty-seven seagoing vessels of 4,000 tons and upward, with a total of 400,000 gross tons. It is not necessary to follow the argument of the General Staff any further to be convinced that in case of a crisis occurring, say, in Honolulu, the Philippines, Porto Rico, or Panama, requiring the instant dispatch of the very moderate force of 25,000 men, the army, because of lack of transportation, would find itself unable to give immediate response. Herein lies one of the most powerful arguments for the encouragement by the United States government of the efforts to upbuild our merchant marine.

TWO CENTURIES AFTER FRANKLIN.

On the 17th of this month occurred the bicentenary of Benjamin Franklin. Not only has posterity assigned to him his rightful position among the greatest and ablest of Americans, but foreigners as well early recognized those qualities of his masterly intellect which placed him among the foremost statesmen and men of science and letters. Undoubtedly his fame rests chiefly upon his public career, his services to his country as a statesman, diplomat, and patriot. An historical figure of international fame, his scientific attainments are overshadowed by his political eminence. And yet, the results of his scientific researches and investigations easily place him in the very front rank of scientific men of the world.

Few, indeed, of us have a proper appreciation of Franklin's work in natural philosophy and electricity. It is true that his classic experiment to prove the identity of lightning and electricity is known the world over; but so general is the ignorance of his other scientific labors, that this great discovery is often regarded merely as a fortuitous and chance occurrence. The utter absurdity of this belief needs no further proof than even slight acquaintance with his painstaking and unremitting study in this as well as other directions; and it is unquestionably true that this experiment was not the origin of a theory, but that it was the culminating test of a line of theoretical reasoning and investigation. Franklin's interest in things scientific was limited in range only by the limits of the knowledge of his time. His splendid versatility and intense interest in all phases of human endeavor led him into branches of knowledge where his remarkably practical mind and sound judgment produced contributions to science of undisputed value. So, his early investigations of chimney drafts were soon followed by the invention of a stove, which embodied the principles of the modern hot-air furnace and other devices of like character.

A subject which at this time possessed a peculiar fascination for him was meteorological investigation, and his knowledge and understanding of the general physics of the atmosphere were far in advance of his period. Franklin was probably the first to institute our present methods of tracing and recording storms from point to point, and his investigations of the Gulf Stream, for the first time using thermometric means of verification, were of great value to navigators. No strange occurrence or natural phenomenon was allowed to pass without investigation by the best means at his command. Thus his friend Priestley, in making public the account of his discovery of oxygen, at the same time published a letter from Franklin telling of an inflammable gas found in certain American rivers, known to-day as marsh gas.

Franklin's studies in electricity were, however, carried out farther and more thoroughly than his various activities permitted him to do with other branches of knowledge, and upon his electrical investigations rest his great claims to fame as a scientist. His introduction to this branch of science, then beginning actively to engage the attention of men of learning in Europe, was through a Dr. Spence of Boston, who possessed some crude apparatus and was acquainted with the work that had been done abroad. Franklin's interest was at once aroused, and his natural inclination to philosophic study of this character soon induced him to make electrical research one of the prime objects of his life, and a hobby which he did not relinquish until his death. Collinson, the English agent of the Library Company of Philadelphia, and the personal friend of Franklin, supplied him with existing English literature on the subject, and soon sent him Dr. Watson's book, as well as one of the tubes used in the experiments. Franklin eagerly took up the closer study of electrical phenomena, and in 1747, with three others, Kinnersley, Hopkinson, and Sing, conducted the famous "Philadelphian experiments," showing the "effect of pointed bodies both in drawing off and throwing off electrical fire." It is almost certain that in these investigations Franklin copied very little from the European investigators; in fact, his scientific surroundings in America almost precluded this possibility. In all probability, he at this time reinvented the static

electrical machine for his own use. His splendid fertility of resource and unflagging energy are demonstrated in no better way than in these experiments, crude, hampered by insufficient apparatus and ignorance of what had already been done, but even so, outstripping the work of the best continental scientists.

Franklin evolved the electric fluid theory acceptable to the non-mathematical mind almost to our day. His work with the Leyden jar was classic, and with his experiments begins the forging of the link between this and the voltaic cells.

In 1748 he decided to retire from public life and business, to devote his entire time to electrical study and research. With this purpose in view he sold his newspaper, almanac, and printing house, and the result of this sale, with the fortune he had previously amassed, enabled him to settle down to conduct his experiments unhampered by lack of time, until again called into public activity a few years later. The work on the Leyden jar was continued with marked success, and at this time Franklin was undoubtedly in advance of most foreign electricians. He conceived and used the arrangement of electrical sources in series, a method hitherto unknown. Further, he made the important discovery, and proved it, that the charge of the jar lies near the surface of the glass itself and not in the metal as had been believed.

Unquestionably, his greatest success was in proving that lightning is an electrical phenomenon. As early as 1746, John Freke, a Scotchman, followed by other scientists, formulated this hypothesis, and unsuccessfully attempted its proof. In all probability, Franklin did not know much about these other theories, and his conception of the identity appears to have come to him early in his investigations, during certain of which he painstakingly observed and noted all the characteristics apparently common to a flash of lightning and an electric spark. In 1749 he sent to Collinson his two famous communications, making known his belief in this identity. Outlined in these letters was a theory of the causes of atmospheric electricity, ingenious though incorrect, which he soon abandoned. He continued his experiments through the summer, and in July of the following year he again sent a long communication to Collinson, giving an account of the experiments in which the invention of the lightning rod is set forth, and outlining a plan for proving that lightning and electricity are of the same character. Collinson recognized the value of the account, and attempted to secure its publication in the Journal of the Royal Society. The Society was not well disposed toward Franklin, and refused to entertain the idea. Cave, the great London publisher, denied the letter space in his Gentleman's Magazine, but consented to print it in book form. This was done, and the publication in 1751 was soon followed by a French translation. The importance of the experiments was recognized in France; and while Franklin, continuing his investigations, was pondering on how to conduct his projected lightning-rod test himself, he learned that it had been successfully carried out by French savants. How this had been done he did not know. He was only acquainted with the bare fact of the accomplishment. Nevertheless, he set to work and soon evolved the kite experiment, which made him famous the world over, and which was followed by his election as honorary member to most of the learned societies of Europe, including the Royal Society of England.

It has been held that had Franklin been able to devote his entire time to science, had his studies been pursued in an environment more suited to work of this kind, and had his opportunities for acquiring scientific erudition been more favorable, his fame today would rival that of the greatest natural philosophers the world has seen. He was essentially the practical man, of politics, of letters, of science, and this characteristic, coupled with sound common-sense and judgment, led him constantly to attempt the realization of scientific principles for purposes of practical utility. His mental attitude was one of unselfishness, of insensibility to ridicule, and carelessness of praise, as witnessed by the characteristic indifference with which he regarded the early shortsighted attitude of the Royal Society. The recognition of Benjamin Franklin's worth and eminence as a patriot, as a statesman, and as a writer cannot be too great, nor can it be too general, but in our appreciation we must not forget what Franklin's work as thinker and investigator has meant to science, the abstract, and to science as applied to the utilities of ordinary life.

THE HEAVENS IN FEBRUARY.

BY HENRY NORRIS RUSSELL, PH.D.

The astronomical news of the past month deals chiefly with comets and nebulæ.

Giacobini's comet, discovered in December, is still visible, but about the first of February it gets so near the sun that it will be invisible (although it will actually be many times brighter than at the time of discovery) since it will only be above the horizon during daylight. Later on, after its perihelion passage, it may be seen again, though the conditions are not favorable.

The discovery of two other comets has been announced from the Lowell Observatory, both being found on the same plate, taken by Mr. Slipher. Unfortunately, moonlight prevented further observations, and now the comets are "lost," and it is impossible to say whether they will be observed again.

The nebula to which we refer surrounds the new star which appeared in Aquila last August. The history of this star is very much like that of other objects of the kind. It was discovered by Mrs. Fleming on a Harvard photograph, on which it showed the characteristic bright-line spectrum. It rose from invisibility to the seventh magnitude between the 15th and 18th of August, and then gradually faded, so that it was never visible to the naked eye.

Now the announcement comes, quite independently, from Heidelberg and from Arequipa, that plates taken in October, two months after the outburst, show a faint nebulosity around the star, about a minute of arc in diameter, which was not present on photographs taken previously. It seems likely that this nebula is intimately connected with the star, as was the case with the similar nebulosity which appeared round Nova Persei in the winter of 1901-2, and that, as in the earlier case, it is spreading out from the star in all directions.

This could be explained in the same way, by assuming that the new star was surrounded by a nebula which was really dark and at rest, shining only by reflected light. As the light of the outburst moves farther from the star, it lights up more and more of the nebula, which therefore appears to expand.

On this hypothesis we may make a rough estimate of the distance of the Nova. If the outer part of the nebulosity is at the same distance from us as the star is, its distance from the star on October 18 must have been about 1/7,000 of its distance from us. But, according to one theory, this is the distance that the star's light had traveled in the two months since the outburst, and it follows by a simple proportion that its light must take nearly 1,200 years to reach the earth.

This distance is much greater than that which a similar calculation gives for Nova Persei—about 250 light years—but it is not at all incredible in itself, for astronomers have long been convinced that the more distant stars are so remote that their light must take thousands of years to reach us.

It would follow that Nova Aquilæ at its brightest sent out about three hundred times as much light as the sun. Large as this amount is, it is small compared with the light of Nova Persei, which at its best was six or eight thousand times as bright as the sun.

It should be remembered that these figures rest upon certain assumptions, which, though pretty well established in the case of Nova Persei, are not yet proved for the star in Aquila. If they are true, the most remarkable of their consequences is the thought that we are now observing and discussing as a new thing an event which really happened in the days of Charlemagne or of Alfred the Great.

Turning from the remote past to the near future, we have to note, as the most interesting astronomical event of the month, a total eclipse of the moon, which takes place on the morning of the 9th. The moon begins to enter the earth's shadow at 12:57 A. M., is totally immersed in it at 1:58, and continues so until 3:30, when her eastern limb begins to come out of the shadow, which she leaves finally at 4:37. All these dates are given in Eastern standard time, and must be corrected by one or more hours if an observer uses one of the other standard times which are current in the central or western parts of the country. This is an unusually long eclipse, as the moon passes almost centrally through the earth's shadow.

There is also an eclipse of the sun on the 23d, but it is only visible in the southern parts of Australia and New Zealand, and the south polar regions, and so is of little concern to us.

The starry heavens afford the finest spectacle they present during the year on these winter nights. If we stand on a clear February night, at about nine o'clock in the evening, and look due south, the first thing we will see is Sirius, the brightest of all the stars. Below it and a little to the left is an irregular cross of brightish stars, which mark the rest of the constellation of the Great Dog. Higher up, and a little more to the left, is the bright star Procyon, the only prominent member of the constellation of the Little Dog. Above this again are two nearly equal stars, Castor and Pollux, in Gemini.

Looking upward and to the right from Sirius we find Orion, and beyond it Taurus, to which Jupiter—now near the Pleiades—adds a greater luster. Still higher, northwest of the zenith, is Auriga with the very bright star Capella.

The constellations in the eastern and western skies are less brilliant. Leo and Ursa Major are the most prominent ones in the east, and Hydra is in the very dull southeastern sky. The southwest, which is occupied by Eridanus and Cetus, is equally uninteresting, and the only other conspicuous constellations are in the northwest, where Perseus, Cassiopeia, and Andromeda lie, and the north, where Draco and Ursa Minor are below the Pole.

Observers in latitudes south of 36 deg.—that is, south of Virginia and Missouri—may at this season see Canopus, which next to Sirius, is the brightest star in the heavens. It comes to the meridian about twenty minutes earlier than Sirius, and can just be seen, low on the southern horizon.

THE PLANETS.

Mercury is nominally a morning star until the 20th, when he passes behind the sun and becomes an evening star; but as a matter of fact, he is too near the sun to be seen with the naked eye this month.

Venus is in a similar situation, passing conjunction on the 14th. On the 22d she is in conjunction with Mercury, and both with Saturn, but all the planets are very near the sun, and hopelessly invisible.

Mars is evening star in Pisces, and sets at about 9 P. M. in the middle of the month.

Jupiter is in Taurus, near the Pleiades. On the 17th he is in quadrature with the sun—that is, 90 deg. east of him—so that he is due south at 6 P. M.

Saturn is in conjunction with the sun on the 24th, and is only visible during the first few days of the month, just after dark.

Uranus is in Sagittarius, and rises at about 4 A. M. Neptune is in Gemini, and sets at about the same hour.

THE MOON.

First quarter occurs at 7 A. M. on the 1st, full moon at 3 A. M. on the 9th (during the eclipse), last quarter at 11 P. M. on the 15th, and new mpon at 3 A. M. on the 23d (at the time of the solar eclipse). The moon is nearest the earth on the 13th, and most remote on the 1st. She is in conjunction with Jupiter on the 2d, Saturn, Mercury, and Venus on the 23d, and Mars on the 26th.

Princeton Observatory.

IMPROVEMENTS NOTED AT THE AUTOMOBILE SHOWS.

This year for the first time two of the largest exhibition buildings in New York were required for the display of American and foreign machines and accessories. At the two shows in Madison Square Garden and the 69th Regiment Armory, nearly 200,000 visitors passed through the gates during the week. The machines exhibited were the product of some 94 domestic and 28 foreign makers. Most of the machines on view were high grade 4-cylinder touring cars or closed limousines of about 24 horse-power. Next in numbers were the light touring cars and runabouts with double-opposed-cylinder motors, while the single-cylinder cars were few. The friction disk transmission seems to be coming into vogue, as no less than three distinct forms of this type of transmission were noted in the armory. A peculiar type of pin transmission somewhat on this order was also exhibited. The greatest improvement in motors lies in the bringing out of a six-cylinder engine by a half-dozen different firms, and the introduction of a four-cylinder two-cycle engine by another. Practically all the gasoline motors have all their valves mechanically operated and are fitted with jump-spark ignition, although a few high-grade machines have low-tension magneto ignition. The high-tension magneto is also a favorite means of current supply with the jump-spark system. In almost every instance, the magneto, as well as the water pump, is driven by inclosed gears running in oil. A low-tension make-and-break magnetic spark plug in which the movable pin is operated electrically was a French invention of interest. A magneto was used to supply the current, which amounted to six amperes with a voltage of 20. Although decidedly inefficient, this plug produced an exceedingly hot spark and was claimed to be oil proof. The electric vehicles shown were larger and more luxurious than ever. Eighty miles on a charge at a speed of 15 miles an hour is guaranteed by several makers. The improvements in the Edison battery noted on another page will perhaps make it possible to do even better than this, although a two-passenger speed machine shown, fitted with the present type Edison cells, had a mileage of only 60 on a charge. This mileage was guaranteed, however, at a speed of 25 miles an hour. The weight of this machine—1,650 pounds—was slightly greater than that of an electric stanhope having a capacity of 85 miles on a charge at 15 miles an hour; and 60 Edison cells weighing 780 pounds were used in the former as against 24 lead cells weighing 625 pounds in the latter machine.

An elaborate display of trucks and commercial vehicles was made in the basement of the Garden. Most of these were electrically operated, although several gasoline trucks were shown. A novelty among the latter was a truck with electro-magnetic clutches for obtaining the different speeds. Three-ton trucks are about the largest that are at present manufactured. Several electric trucks of this capacity were shown. Solid rubber tires (and in some instances twin tires) are used on these vehicles.

THE UNGENTLE ART OF BURGLARY.

Burglary—specifically safe-breaking—has in the last decade gradually ceased to be an exact science. To-day the safe-breaker no longer requires those beautifully fashioned, delicate yet powerful instruments and

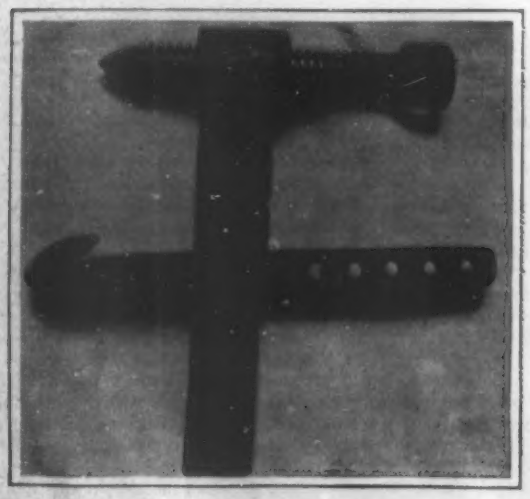
Jack-Screw Used to Lift Safes Into the Proper Position to Blow Them Apart.

tools which were formerly both the admiration and the despair of the safe manufacturer. The modern "yeggman," tramping it casually along a country road with a three-ounce phial of nitro-glycerine, a tiny battery, a few yards of wire, and an ignition-cap in his pocket, is able to open and rob almost any kind of a safe, if not with neatness, certainly with dispatch. No longer is the ambitious "strong-arm" man doomed to hours of exhausting and necessarily noiseless drilling, wedging, spreading, or jacking; for the introduction of nitro-glycerine, "soup" in technical parlance, has not only obviated these onerous labors, but has again enabled the safe-cracking industry to gain a step on the safe-making one. From the earliest days of the safe proper, the contest between the maker and the breaker has been closely analogous to that between the armor-plate manufacturer and the gunsmith, with the safe maker a little in the lead. That is, while no safe can ultimately withstand a persevering and scientifically directed attempt to open it, yet it may be sufficiently strong to resist an attempt limited in time as a burglar's operations usually are.

The use of nitro-glycerine, however, has dealt this time element, so favorable to the enforced honesty of the burglar and the continued security of some citizen's valuables, a knock-out blow. With the exception of such vaults of larger size, guarded by time-locks and electric alarms, usually the property of the more powerful banks and trust companies, and possibly the new globular type of strong-box, no safe is safe from the peripatetic yeggman—in daylight the harmless vagrant, and at night the terror of the country bank official and that picturesque but inefficient guardian of the peace, the country constable. The simplicity of the yeggman's methods is as great as that of the old-fashioned safe that so often is his "meat," but even safes of modern design and large size fall or, rather, meekly open before his ruthless and explosive attack. Even if the crack surrounding the door of the safe be so small as barely to allow the insertion of a sheet of paper, it is sufficient to permit the entrance of the "soup," a thin yellow, slightly viscous liquid flowing as easily as ink. Sometimes this is facilitated by a few blows of a muffled hammer on a steel wedge to widen the opening. After this, the nitro-glycerine is introduced, either by means of a funnel or by forming a sort of cup of putty around the opening, located at the top of the door. The ignition-cap is then placed in position and is connected with the pocket battery by means of wires which are brought in contact to make a spark—and the safe door starts on an aerial journey checked by the judicious use of a blanket. The yeggman, however, is often an inartistic, untidy workman, for it frequently happens that when the door suddenly parts company with the safe it takes the front of the building with it, and consequently the selection of the valuables desired from the contents of the strong-box is often so hurried that it is only partially successful. The bombardment of the surrounding territory with portions of the Farmers' National Bank seldom fails to rouse from slumber even the soundly-sleeping tillers of the soil. One form of safe, however, spherical in shape with a spherical door, appears capable of successfully resisting a nitro-glycerine attempt of this kind, as it is absolutely air-tight, and with the consequent absence of an appreciable opening between the safe and the door the insertion of the explosive is almost impossible.

The modern safe is practically proof against the burglar who works without the aid of explosives, for the above-mentioned time element is an almost insurmountable difficulty. Burglars, like lovers, laugh at locksmiths; they also sometimes laugh at time. In a recent store robbery in New York city, the gentlemen lacking a proper appreciation of *meum* and *tuum* approached the scene of their labors with a dray, opened the front door of the emporium, and carried off the safe bodily, to be opened later at their leisure.

The instruments shown in the accompanying engravings are among those in a collection at the New York police headquarters. Some of the implements are out of date, and have been since the early days of safe-making; others are still in use, and will probably continue to be used as long as the industry flourishes. Among the latter we may include the jimmy, an implement found in the hands of even the most dilettante of burglars. The jimmy *per se* is nothing more or less than a powerful crowbar for opening windows, prying apart locks, moving safes, etc. It is to the burglar's ungentle art what the brush is to the painter's more polite vocation. With the aid of a two-foot jimmy it is comparatively easy to move even a four or five-ton safe into a more favorable position for operating on it. Sectional jimmies, generally the property of men of rank and experience in the profession, usually consist of one or two straight bars threaded at each end, a union to join them, a number of heads of the different shapes demanded by the exigencies of the circumstances, to be screwed onto the bars, and often a number of auxiliaries for various purposes. By means of one of these, for instance, the jimmy may be converted into a powerful spreader, so called, for forcing apart plates and the like. For this purpose two straight bars, an end of each turned into a right and a left-hand screw thread, respectively, are joined by a central piece tapped to correspond with the ends of the two bars. This piece is also provided with means for turning it to force the two bars and the points of their application irresistibly apart. As shown in another photograph, the larger sections of the jimmy are sometimes carried in two leather or cloth tubes or bags, joined by a strap and suspended around the burglar's neck and buttoned inside his waistcoat. Experts claim that this is a most efficient and little troublesome method unless the number of acquaintances of the gentleman necessitates frequent bowing. But at 3 A. M. even a burglar's friends are not omnipresent, and no one bows to a policeman. The small lifting jack is of the ordinary kind, and differs little from those used in more legitimate industries, with the exception that its construction is unusually light and compact, yet powerful.



Drag for Tearing Off Locks and Plates.

The set of skeleton keys needs but little explanation. They are used for opening ordinary locks wherein tumblers are employed, and are of course useless as far as safety or combination locks are concerned. Where a lock contains a number of tumblers, it may be necessary to use a number of keys, but even in simpler cases the success of the operation depends to a great extent upon the skill of the artisan.

The funnel and syringe illustrated in another photograph are merely used to force the explosive into the drilled hole or the widened door-crack. The plunger of the syringe is covered with cotton, and other precautions are of course necessary to insert the explosive safely in this manner, as a premature explosion, instead of opening the safe, would probably perform that operation upon the safe-breaker.

The bludgeons or black-jacks shown in the engraving have all been wielded by strong-arm gentry of ruffianly proclivities, and have figured in famous crimes whose gruesome details it is unnecessary to recount here. But one glance at the photographs is necessary to convince the observer that these implements fully equaled the expectations of their makers, especially in the case of the excellent design involving the use of the helical spring.

The two remaining instruments have practically become obsolete through the advance in the art of safe making. The "drag" was used for tearing off locks, plates, and the like, the hook being caught under the object to be removed, while the point of the screw and the other end of the cross-piece were held against some other part of the safe. Few of the older safes could resist the powerful pressure brought to bear in this manner. The contrivance shown for cutting out a combination lock is comparatively simple. It is merely secured to the knob by means of the hole located between the two cutters, and the cutting is performed by turning the contrivance around the knob as a pivot, by means of the handle shown at the extremity of the upper bar. The cutters are advanced after each revolution, by a turn of the nut on the threaded bar between them. Verily, the way of the transgressor must have been hard if he were forced to carry this ponderous implement any distance. The same brains and labor turned to honest ways would in the long run give a greater yield—a trite remark, but like many of its kind, only too true.

Contrivance for Cutting Out the Combination Lock of a Safe.

The hole between the cutters is placed over the knob and the tool is turned by means of the handle.

The Effect upon Fishes of Supersaturated Water.

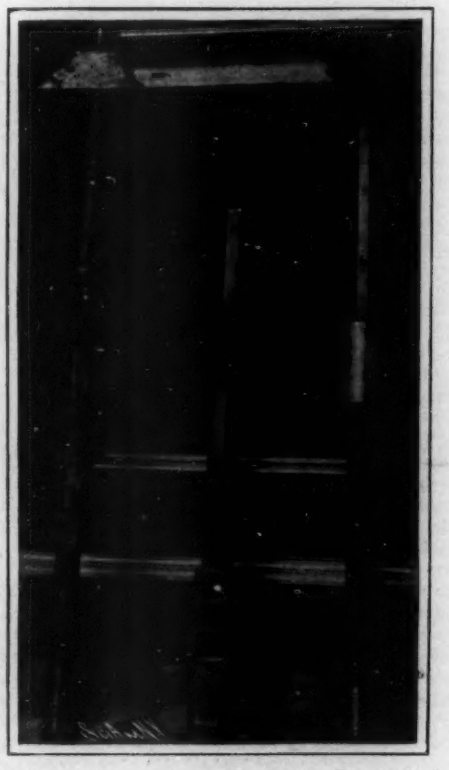
BY H. C. MARSH, UNITED STATES BUREAU OF FISHERIES.

Under normal conditions fishes live in water which contains no more dissolved air than may be absorbed spontaneously at atmospheric pressure and the prevailing temperature. As the nitrogen and oxygen of the atmosphere are not very soluble in water, the maximum amount dissolved at 0 deg. C. and 760 millimeters Hg is not large, being 19.53 cubic centimeters per liter of the former gas and 10.18 cubic centimeters per liter of the latter. When these amounts are exceeded, or when the corresponding content for any particular temperature and pressure is exceeded, the water is supersaturated, and while it remains in this condition it may cause remarkable symptoms upon fishes which often result fatally. An investigation of the subject has been conducted by Prof. F. P. Gorham and the author for the United States Bureau of Fisheries, and results obtained are here briefly summarized.

At the station of the United States Bureau of Fish-

eries at Wood's Hole, Mass., an instance of sea water with an excess of air occurred. This was due primarily to a leaky suction pipe which allowed air to enter it and pass with the water to the steam pump which lifted the water to storage tanks about 18 feet high. Having passed through the pump, this mixture of water and air became subjected to a hydrostatic pressure of about 8 pounds which forced the air into solution. From the storage tanks the water flowed to aquaria and being again at atmospheric pressure was in a condition of supersaturation with air. Air constantly escaped from it, both by separation in bubbles upon the sides of the aquaria and by escape at the surface. The constant flow, nevertheless, maintained the supersaturation. The fishes showed a variety of symptoms. There was first a precipitation of very minute bubbles upon their bodies and fins, completely covering them. After a longer time blisters of gas formed in the skin, chiefly of the fins, and sometimes became so large as to buoy the fish so that it could scarcely keep below the surface. With some species the eyeball was partially extruded from the head, causing the symptom known among fish-culturists as pop-eye. This exophthalmia was caused by an accumulation of gas behind the eye.

Death resulted after a longer or shorter time. The external gas did no serious harm, but death was due

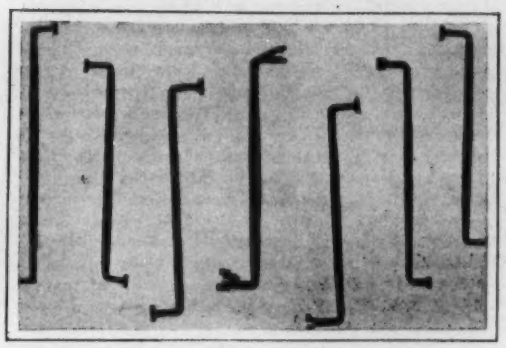


Sectional Jimmies Are Generally the Property of Burglars of Distinction.

to free gas within the blood vessels—to gas embolism. Often the vessels of the gill-filaments were filled with gas, and the ventral aorta and bulbus of the heart distended with it and quite empty of blood. This gas was about 97 per cent nitrogen.

The water itself, when the dissolved air was determined, was found to contain an excess of both oxygen and nitrogen. By controlling the amount of air which entered the suction different degrees of excess could be produced. On one occasion the water at 10.5 deg. C. contained 18.79 cubic centimeters of nitrogen per liter, an excess of about 6.4 cubic centimeters; and 8.41 cubic centimeters of oxygen, an excess of 2 cubic centimeters per liter. This water was fatal to hake within 8 to 20 hours, and it is probable that no fish could long survive in it. When the excess was not so great, a longer time was required to kill. A supersaturation of about 2 cubic centimeters of nitrogen per liter of water is sufficient to cause symptoms upon some species, but with less than this fishes may live perhaps indefinitely though there is probably some functional disturbance.

The gas which is chiefly or entirely responsible for the symptoms and fatalities is nitrogen alone. Natural waters are not infrequently air-supersaturated with nitrogen at their origin, and this condition is usually accompanied by a deficiency of oxygen. Substantially the same results may be brought about by such water as by that described above. In either case the water may be corrected by thoroughly exposing it to the air, which removes the excess of the one gas and supplies the deficiency of the other. The exposure must be very intimate, however, and requires that the water be broken up into slender streams, as by passing through a bottom with many small perforations; or by dividing



Complete Set of Skeleton Keys. Of Use Only in Picking Locks with Tumblers.

into thin sheets. Two and one-half gallons of supersaturated sea water in a cylindrical open vessel required more than two days to discharge spontaneously its excess of air. The presence of the free gas within the blood vessels is to be explained as a precipitation from the blood due to a rise in temperature. The high osmotic pressure of the air dissolved in the water forces unusual amounts of air into solution in the blood by way of the gills. After leaving the gills the blood is warmed slightly by the oxidation processes, and the difference in temperature between the water and the blood in the heart amounts in some cases to several degrees Fahrenheit. Thus the blood slowly releases some of its dissolved air—more strictly its dissolved nitrogen—which accumulates until a stasis of the circulation occurs, and consequently the death of the fish. A marked analogy exists between this affection and the caisson disease in man. In the latter the body sustains an actual increase of pressure which is subsequently removed and the symptoms follow. This change of pressure has no counterpart among fishes, save that the origin of the supersaturation is referable to an increase of pressure. Fishes may suffer the disease without necessarily undergoing any change whatever in the hydrostatic pressure which they sustain. The analogy lies in the supersaturation of the blood which occurs in both man and fishes. In deaths among caisson workers free gas is often found in the blood vessels. A rapid decompression of course favors the precipitation of gas and the precautions for avoiding harmful results include a gradual reduction of the pressure to normal.

An increase of pressure may be used to prevent the gas symptoms among fishes. If water supersaturated with air is subjected to a sufficient increase of pressure the supersaturation no longer exists, though the actual amount of dissolved air may not be changed. In such water the saturation point of the blood and other fluids of the fish, as well as of the water itself, is raised and while the increase of pressure remains the fish will suffer no harm from superaeration.

The attention of inventors may be usefully directed to the importance of the early patenting of their inventions in Japan, says the Journal of the Society of Arts. Imitations in Japan of foreign inventions not protected there by patent are not uncommon. Inventions hitherto regarded as having no direct bearing on the trade of the Far East may turn out to have much to do with it, and unless inventors patent their inventions quickly they may find it too late when they become alive to the necessity of patenting. The Japanese Patent Bureau places in its library the official Patent Gazette of the foreign country containing the description of an original invention, after which such invention is unpatentable, and comes under the clause "publicly known," as covered by Article 2 of the Japanese patent law.

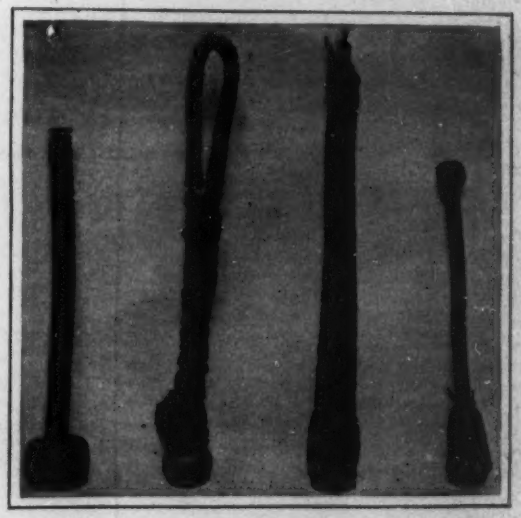
A Burglar Carries His Jimmies and Tools Around His Neck Strapped Inside of His Coat.

THE UNGENTLE ART OF BURGLARY.

Long Fasts of Spiders.

Moses and Dr. Tanner seem to be man's models in the ability to dispense with food. The limits reached by them, however, are greatly surpassed by certain animals. Some facts as to spiders' powers of fasting are given in L'Illustration (Paris), September 23. An eminent naturalist, M. J. H. Fabre, recently studying the habits of the *Lycosa narbonensis*, noticed that that spider carries its little ones upon its back during seven months, and that during this time the young spiders consume absolutely no food. He concluded from this observation that it is the solar heat and light that for them directly take the place of nourishment. In other words, "the motor heat in these young animals, instead of being released from the food, might be utilized directly as the sun, source of all life, radiates it."

Syringe and Funnel for the Insertion of Explosive.



Bludgeons Which Have Equaled the Expectations of Their Owners.

A Berlin electric company has lately brought out a novel apparatus for testing insulated cables by means of X-rays. Up to the present time it has been impossible to verify the insulating qualities of the cables and their conductibility except by measurements which are carried out with electrical instruments, and the process is often a long or difficult one. With the new instrument the cable may be examined at once and the experimenter may be said to actually see the insulation of the cable, by means of the rays. The cable is made to pass over two pulleys which are fixed at the upper part of the instrument. An X-ray apparatus projects the shadow of the cable upon a fluorescent screen as it passes along. The impurities and air-bubbles in the insulating layer are clearly visible on the screen. In practice the apparatus is made portable, so as to be used in a cable factory. A large case mounted upon wheels contains all the apparatus, with the two sheaves for the cable on the top. Underneath the cable is the X-ray tube and above it the fluorescent screen. The cable is unrolled slowly and is examined as it passes across the apparatus.

A NEW AND INTERESTING OVERHEAD TRAVELING GEAR FOR EXPEDITING CONSTRUCTION IN SHIPYARDS.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A new departure in the facilities for expediting the construction of vessels has been carried out at the Jarrow-on-Tyne shipyards of the Palmer Shipbuilding and Engineering Company. In the majority of yards the practice invariably adopted for the handling of the material employed in the construction of a vessel is by means of overhead gantries, or overhead and transporter cranes. The system recently erected at this well-known British yard, however, is entirely different from the prevailing equipment, and its operation is being followed closely by shipbuilders in general, since it possesses several advantages over the existing type of plant.

When the Palmer Shipbuilding Company received the contract for the construction of the 16,500-ton battleship "Lord Nelson" for the British Admiralty, in order to carry out the constructional work with the greatest possible expedition, it was decided to adopt a new type of traveling and lifting gear. The objects demanded were convenience both in handling and operation, the transit of the constructional materials to the point of erection in the minimum of time and with the minimum of handling, and accessibility to any desired point of the vessel in erection.

The general arrangement of this system can be gathered from the accompanying illustrations. The equipment comprises an application of the suspension cableway which has proved so successful in other constructional work, such as viaducts, bridges, and so forth. At either end of the berth is erected a cross girder of special design carried upon inclined posts or columns. The latter are inclined to about 45 degrees, so that they have an overhang beyond the extremity of the berth at each end. The supporting posts are built upon the lattice-girder principle, tapering somewhat at both ends. They have their footing upon masonry piers or seats, formed to receive them on each side of the vessel, and are anchored by two vertical cables set up with stretching screws. The upper ends of the inclined supports are connected by a bridge built in two sections, with a clear open space between throughout the entire width of the span. The equipment is so erected that there is a clear longitudinal span of 500 feet from support to support, and a transverse clearance of 100 feet.

By inclining the supports outward from the berth at either end, the overhead gear is arranged so that the hoisting and traveling machine can be brought right over the works railroad at the land end, and can remove the material direct from the freight cars to the point of construction. The same facilities are insured at the opposite or water end, it being possible in this case to carry the lifting tackle if necessary clear into the hold of a vessel and hoist it free of the deck. By means of the overhang, also, it is possible to have complete access to a vessel moored at the end of the berth over an area 100 feet in length, and in this way more complete and easier access is feasible for repairing or other purposes, the overhanging bridge serving the same services as sheer legs, with the additional advantage that a larger section of the vessel beneath is simultaneously brought within the scope of the lifting equipment.

There are three sets of cableways, each constituting a complete unit in itself. The system adopted is that of Messrs. Henderson & Co., of Aberdeen (Scotland), which has proved so successful in various other undertakings. The main cables and driving ropes for each cableway, instead of being anchored at the ends, are attached to carriages which run on tracks provided on the lower sections of the end bridges, or cross-girder members. This arrangement enables each unit to travel and operate transversely across the full extent of the berth, and the gap between the two sections of each bridge gives a clear passage for the various ropes. It will thus be seen that every part of the berth can be served by the overhead gear. Furthermore, the three traveling and hoisting units can be utilized, if necessary when handling a large piece of material, in combination.

The cableways have an approximate longitudinal speed of 600 feet per minute, and have a hoisting capacity of 3 tons at 100 feet per minute, or one ton at 150 feet per minute. The traverse or cross-travel speed of the cableway is about 25 feet per minute.

On each of the trolley carriages there is accommodation for the operator, who is able to control therefrom the hoisting, lowering, longitudinal, and cross-traversing motions. The whole of the energy employed for the various motions is electricity, the current being alternating at a voltage of 440.

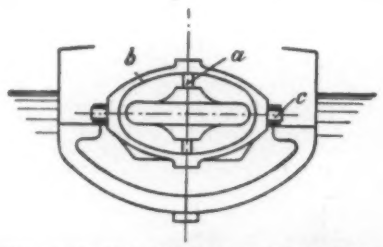
Owing to the fact that the gear is able to serve every part of the berth, the convenience and value of the system from labor and time-saving points of view are readily realized. It is also possible to control the hoisting operations with greater facility and celerity than by the orthodox methods; and the rapidity of the traveling and hoisting motions, which are far in excess of those attainable with cranes or gantries, enables the workmen to be better supplied with materials. When the contract for the "Lord Nelson" was awarded to the Palmer Company, owing to the short time allowed for the construction—the warship has to be completed and placed in commission within three years—it became imperative to devise a more expeditious system of handling the constructional material, and that system now in operation was designed by Mr. Twaddell, the company's shipyard manager, as being the most suitable method of attaining this end. The value of the plant from this point of view has already been conclusively established, the constructors having been able to work a greater quantity of material into the vessel, and to advance the erection to a stage which would have been impossible with the former equipment. An appreciable economy in the cost of the undertaking has also been effected.

Although this plant was erected largely as an experiment, it has proved so satisfactory that the system is to be extended throughout the yard. A second structure on similar lines is to be built almost immediately, only in this instance it will be of greater dimensions, so that it will cover and serve two berths simultaneously, each 700 feet in length. The plant has been inspected by many of the most prominent British shipbuilders, and it is stated that the system is to be applied to several other yards.

SCHLICK'S MARINE GYROSCOPE IN USE.

The Schlick gyroscope, which was described in the SCIENTIFIC AMERICAN of July 16, 1904, and which is intended to minimize the rolling motion of a ship, has been practically applied.

It will be remembered that Schlick utilized the forces set up in a freely-hung gyroscope by inclination



SCHLICK'S GYROSCOPE FOR THE PREVENTION OF SEASICKNESS.

of its support. The apparatus consists, therefore, of an Archimedes wheel which is rotated at a high speed. The forces brought into play by the rocking of the flywheel support are the result of the rolling motion of the ship. This motion must be considered in designing every vessel. For if the period of a vessel's oscillation, that is the time which elapses in rocking once from side to side, is not carefully determined, it may happen that the period of the rolling motion may agree with the wave period with the result that the ship will be capsized. According to Schlick, the waves of the Atlantic Ocean have an average length of 600 to 700 feet, and a period of about 12 seconds. During storms, however, they may attain a length of 2,800 feet, and a period of 23 seconds. Naval architects, therefore, give their vessels a period of oscillation considerably greater than that of the period of the smaller waves. The dangerous forces set up by rolling are supposed to leave the ship unharmed if the gyroscope is used.

Schlick's gyroscope is mounted with its vertical axis, *a*, in a frame, *b*, turning freely on a horizontal axis, *c*. If the ship begins to roll, the gyroscope is set in motion and by reason of its inertia will tend to continue in motion. The result is a partial rotation of the frame *b* about its axis. But forces are then set up which oppose this rotation of the frame *b*, so as to retard it and to restore it to its initial position. Since the rolling of the ship is the cause of the frame's inclination, it follows that this very rolling is opposed. If the rolling motion should be considerable it may happen that the frame *b* will rotate through an angle of 90 degrees, thereby completely overcoming the opposing effect. In order to prevent such an occurrence, a brake is employed. Furthermore, it is essential that some device be employed which will tend to keep the flywheel in its original position, for which purpose the frame *b* is provided with a weight at its lower part.

Schlick recently described his invention to the Hamburg Nautical Society. It was objected by some member that the flywheel would assume such large dimensions, and would weigh so much, that its use on seagoing vessels was impossible. To this Schlick replied that for a vessel of 6,000 tons displacement, having an oscillation period of 15 seconds, a flywheel 4 meters in diameter, with a weight of 10 tons, would be sufficient to overcome the rolling motion. It was furthermore objected that a ship should adapt itself to the heaving of the sea. To this it was replied that sailing vessels roll heavily with reefed sails, and ride along steadily under full sail without the slightest rolling motion and without any injury to the hull.

In order to prove the practical value of his invention, Schlick has installed a gyroscope in an old torpedo boat. The cast-iron flywheel has a diameter of about a meter, and weighs 700 kilogrammes. It is mounted well forward of the boilers. At its lower end the shaft of the flywheel runs in ball bearings, thoroughly lubricated by means of an oil pump. The flywheel itself is driven by a steam turbine, having a speed of 1,600 revolutions per minute. How great is the energy stored up in the rotating wheel, may be gathered from the fact that after the steam of the turbine had been cut off, during one experiment, the wheel persisted in spinning for some three hours before it finally came to rest. In order to control the flywheel frame, a double-acting hydraulic brake is employed, the cylinders of which are filled with glycerine. It is said that the experiments which have been made with this torpedo boat have more or less proven Schlick's point.

Silicide of Copper.

In a paper recently presented to the Académie des Sciences, M. Paul Lebeau gives an account of his researches upon an industrial silicide of copper which is obtained in the electric furnace. He had occasion to work with a silicide containing 50 per cent of silicon. The analysis which he made of this body gave some interesting results which may give some new ideas as to the silicides of copper. These bodies have been studied at times, but a definite compound does not seem to have been formed before M. Vigouroux prepared a $SiCu_2$ by heating copper and silicon in the electric furnace. The excess of copper distilled off, and when cooled very slowly the remaining mass had a crystalline texture and corresponded to the above formula. About the same time Chalmot showed the existence of a silicide of copper $SiCu_2$, which he prepared by heating a mixture of sand and charcoal in the presence of copper in the electric furnace; afterward he showed that the silicide he obtained was in reality a mixture of $SiCu_2$ and free silicon, and found also that the silicide $SiCu_2$ is easily decomposed, for free silicon is found in copper treated with 14 per cent of silicon. M. Vigouroux, by passing a current of silicon chloride vapor over copper heated to 1,200 deg. C., obtained an ingot containing less than 5 per cent of combined silicon. By treating this compound with silicon chloride a second time he could not exceed 10 per cent of silicon in the combined state. He considers that the silicides of copper of high values which are prepared in the electric furnace are perhaps only the result of a special equilibrium obtained by the high temperatures and can only be maintained by a quick cooling which prevents the separation of a part of the combined silica. The industrial silicide which the author observed has a slaty blue color on the surface, with a brilliant crystalline section when broken, having the brilliancy and color of silicon. On a polished surface the microscope shows large crystals of silicon between which is solidified the silicide of copper. In the middle of the latter are smaller crystals of silicon of a second formation. Separating out the combined silicide of copper he finds that it does not reach the proportion of $SiCu_2$, but is near $SiCu_4$, corresponding to 10 per cent of combined silicon.

The Current Supplement.

The current SUPPLEMENT, No. 1569, opens with an interesting review by the Paris correspondent of the SCIENTIFIC AMERICAN of the Novelties of the Paris Automobile Show. Lieut. Henry J. Jones's most excellent treatise on armored concrete is continued. It was but natural that the evolution and success of the steam turbine, occurring at practically the same time as the development of the internal-combustion engine, should lead to the invention of the gas turbine. For this reason an interesting type of gas turbine which has recently been invented is described in the SUPPLEMENT. Mr. S. P. Newberry's splendid practical observations on concrete building blocks are concluded. Of the minor articles we may mention those on the Production of Natural Gastric Juice, Treatment for Electrical Shock, Artificial versus Natural Dyes, Lunar Photography. "The Electric Spark" is the title of a very instructive and exhaustive paper by Dr. G. A. Hemsalech. The usual notes will be found in their accustomed places.

A decision has been rendered in the United States Circuit Court for the Southern District of New York, relating to the well-known escalator employed at various elevated railway stations and in many department stores. The case arose under the basic patent on the escalator, which was obtained through the SCIENTIFIC AMERICAN patent agency by George A. Wheeler in 1892. The particular feature involved is the use of a traveling handrail, and Judge Wallace held that the patent is infringed by the use of a traveling handrail on a traveling stairway of any kind. The claims to the main features of the escalator were not involved in the suit.

Correspondence.

Screw-propelled Cunarders.

To the Editor of the SCIENTIFIC AMERICAN:

It is so seldom that I find an error in your valuable publication, that it rather pleases me to point one out that occurs on page 508 of the issue of December 23.

In the article entitled "The Turbines of the 'Carmania,'" in the second paragraph, you refer to the "Russia" as the first of the screw-propelled Cunarders to sail to the port of New York, and you give the date as 1867. Now the fact is that the steamer "China" sailed from New York on her first return voyage to Liverpool on April 9, 1862, and she was the *first* screw-propelled Cunarder to sail from New York. I happen to know this because I sailed from Boston just one week before in the "America," and while in Europe I made the acquaintance of three gentlemen who sailed on the "China," and who always spoke of her as being a screw steamer. CHARLES T. BARRY.

Roxbury, Mass., December 26, 1905.

Chinese Music.

To the Editor of the SCIENTIFIC AMERICAN:

In "Chinese Music," by J. A. Van Aalst, p. 49, No. 2, the author, in describing the *pien-ch'ing*, or stone chime, says that it is "composed of sixteen stones suspended from a frame. These stones measure 1.8 feet one way and 1.35 the other, and differ only in thickness; the thicker the stone the deeper the sound." The stones are cut in shape of a carpenter's square, with the blades or legs much wider.

Questioning the conclusions of Van Aalst, I had cut two specimens of plate glass, similar in form to his illustration. They were of equal length and breadth, but one was much thicker than the other. The thinner gave out the deeper sound, as I suspected, and just the opposite of Van Aalst's statement.

E. H. HAWLEY.

U. S. National Museum, Washington, D. C., January 9, 1906.

Lubricating the Under-water Surface of Ships.

To the Editor of the SCIENTIFIC AMERICAN:

The letter signed D. B., which appears in your present issue, brings up a question of the utmost importance to owners of all kinds of seagoing craft, more especially to the owners of racing yachts both sail and steam.

His first idea relative to the pumping of air through small holes in a pipe which passes down the bow of a vessel and along the keel, to produce air bubbles to act as friction rollers, is most certainly a novel one. Possibly it might interest D. B. or some other of your readers, to know that experiments to determine the efficacy of this can be made on a small scale, and the merit of this idea much more easily determined than by getting some friendly owner to make such trials.

Four or five years ago, the marine inspector of the North German Lloyd made, at the instigation of certain interested parties, experiments to determine the relative friction caused on the bottoms of vessels coated with grease paint as compared with varnish paint. He conducted these experiments by pulling a wax-coated model through a small tank and registering the resistance. He then pulled the same model with a coating of varnish over it through the tank, again registering the resistance. The result thus obtained was much more decisive than it would have been had the experiments been conducted on steamers, where so many considerations come into play to make the result a doubtful one. There is no reason why such experiments could not be conducted on a model containing a small air pump to distribute the air around the under-body. The resistance should be compared to the pulling of the same model through the water with the air shut off and the bottom coated with varnish, for a varnish surface, contrary to the general opinion, offers less resistance to the water than a grease surface. This was most conclusively proved by the trials of the North German Lloyd inspector. The experiment is well worth trying, for it might be of valuable service to the owners of racing craft.

With regard to the pumping of kerosene through these holes to hinder the submarine growth, I am afraid that this would be found to be not only most expensive, but of doubtful efficiency. The best antifouling compositions on the market now accomplish their work for a period of from six to twelve months. This is due to the high percentage of mercury they contain. The submarine growths settle on the bottoms of vessels in the form of ovules or larvæ, and to prevent their attaching themselves to the metal they must be instantly coagulated. A solution containing one part of bichloride of mercury to fifty thousand parts of water is a more effective coagulator than kerosene, and very much cheaper. The mercury in the antifouling composition disintegrates slowly through the action of sea water, forming soluble mercurial compounds, which hover around the bottom of a vessel, coagulating all ovules, larvæ, or cirripedia that seek to attach themselves.

I must apologize for taking up so much of your valuable space, but the protection of the under-water surface of ships constitutes a science that is little known to the general public but is, however, of great interest.

New York, December 28, 1905. T. W. H.

A Unit for Light Measurements and a Centigrade Photometer.

To the Editor of the SCIENTIFIC AMERICAN:

We have the meter for measuring length and contents, the second for measuring time, the lactometer, hygrometer, and barometer for measuring various other values; but, although we have *the name* "photometer," there is no standard and no unit of generally accepted usage with which to express light values. Saying, "It is 50 degrees Celsius," we will be understood by almost any intelligent and civilized being, but if we should wish to express the light value prevailing, we can only do so in a very general way by stating perhaps, "This is a light room," or "It is very dark here." Why should not the architect be able to say, "This room will have 5 degrees of light on a bright noon," and we understand him? Why not the school teacher complain that "zero" was insufficient for his aula, or the physician prescribe "minus 20 degrees" as the light most convenient for a sickroom?

This deficiency has been most keenly felt in photography and kindred arts, and various devices have been invented to overcome it; all of these, however, suffer from the serious defect of not being based upon a standard or unit of light values which will admit of being generally accepted.

In submitting the following proposition, I believe by no means to have solved with one Alexander stroke this vexed question, but to be on the right track toward establishing such a value.

I propose to call "zero" the light force of the sun exerted during the first second after sundown (6 o'clock P. M.) upon a horizontal, light-sensitive surface, in a determined locality, and under determined conditions.

I propose to call "plus 100 degrees" the light force of the sun exerted during the first second after noon (12 o'clock M.) in the same locality, and with equal conditions as for "zero." The interval between these extremes should be divided into 100 degrees, and the scale thus established could be extended above 100 and below zero.

An ideal locality would appear to me to be any place on the equator on September or March 21, or any other point between the northern and southern tropic on equivalent days regarding the position of the sun. The observation, in order to avoid as much as possible atmospheric influences, should be taken at an altitude of 100 meters, while the sky is cloudless, the horizon unobstructed, and the humidity of the air medium. While this may appear as a long list of conditions, hard to comply with, there would be, I believe, no difficulty to find a locality where they prevail.

I have proposed the measurement to be made by a sensitized surface, having thereby in view a standard emulsion of some silver salt as it is now used in dry plates and photographic papers; but if a plan could be devised promising more stability, accuracy, and permanency, it should of course be preferred; however, the measurements should on no account be delayed for the want of an absolutely correct apparatus.

The system suggested by me has this in its favor:

1. It establishes a unit and a scale of light values.

2. It is as simple and elastic as the thermometer, and instruments *á propósito* could easily be devised after the standard has once been established.

3. It is a permanent standard taken from natural conditions which "we always have with us," and therefore may be verified and rectified at any time.

4. The scale being Centigrade, is easily memorized and fixed in one's mind.

This may be said against it:

1. It would be difficult to locate a place where the conditions required exist.

2. It would be impossible to devise an instrument recording the theoretical values so as to be easily read and utilized and sufficiently accurate.

The first of these objections had been made also when the meter was to be defined as the ten-millionth part of the earth's quadrant; and as regarding the second, while absolute accuracy of course would be desirable, a slight error should be of as little consequence as has been the error which occurred in the observations of the French commission which was appointed to fix the length of the meter. The idea of an instrument for measuring light values is already applied in the various exposure meters on the market for photographical purposes, and these, founded upon a unit as suggested in this paper, could easily be converted into photometers of general utility, if no better device in the meantime should be produced.

The best plan in the writer's opinion to establish this light unit and make the necessary observations would be by appointing an international commission; the next best, that for this purpose some of the funds be utilized, which are available for scientific investigations; and finally measurements could be taken by isolated but trustworthy persons, and the observations obtained by them tabulated and compared, and from these data the standard unit determined.

GUILLERMO BUTZINO.

Havana, Cuba, December 20, 1905.

Power Production of the Future.

To the Editor of the SCIENTIFIC AMERICAN:

Economy in the production and use of power must be, in an increasing sense, the watchword of the industrial life of the future. Our dynamical resources, particularly fuels of various kinds, vast as they are, must be, in the nature of the case, limited; so, as population increases and the uses of power multiply in inverse proportion to the reduction of its sources, all measures looking toward economy in both its production and its use excite increasing interest from all thinking men. Both engineers and political economists are especially interested in this question as the industrial and political activities of society are so closely linked.

The main dependence of the future for power, it would seem, must be in the fuller development of our water powers which are as yet only in the very infancy of their growth. The time is perhaps not far distant when every mountain stream capable of developing horse-power will be harnessed to electrical machinery delivering energy to near-by mills or distant cities. This is especially true of the South where the rainfall is copious and regular and the streams free from ice for the greater part of the year. The fullest utilization of this source of cheap power awaits the perfection of the methods of electrical transmission and transformation which are as yet crude and wasteful. A collateral advantage of the creation of great reservoirs for power purposes in the interior of the country, which I have not seen suggested, relates to their possible effect on climatic conditions in the surrounding country. Will not the presence of these artificial lakes, when sufficiently multiplied, retaining water summer and winter, have an appreciable effect on the humidity of the atmosphere regulating the rainfall, and correcting to some extent the disastrous results of forest destruction which has practically denuded our hills of timber, thereby rendering more frequent drouths in summer and floods in winter? So, as always in human progress, the development of one opportunity will perhaps bring unexpected good results in its wake.

But in the immediate future the hopes of the industrial world for cheap power must be centered on the perfection of the gas engine. Already remarkable progress has been made with this invention which its advocates believe is only an earnest of what the future has in store for it. When the ultimate form of the engine itself—the gas turbine—shall have been perfected, which perhaps may be some time hence, and the process of gas production somewhat improved we will have a prime mover, when linked directly to an electrical dynamo, of the highest thermo-dynamic efficiency and economy.

With the development and general use of the gas engine another vast economy will be made possible. This in the realm of transportation. Instead of hauling coal at great expense to the centers of industrial activity it will doubtless be found both convenient and economical to convert the fuel into gas at the pit's mouth and convey it by underground main to the city to be thence distributed for industrial and domestic uses, and besides with an entire absence of the dust, grime, and smoke incident to the transportation and use of coal, particularly soft coal, in the city.

In this use of fuel gas is to be found an abatement of the vexing nuisance of clouds of stifling smoke which afflict manufacturing centers like Pittsburg.

Until the methods of transporting electrical energy over long distances have been considerably improved, on account of the loss of power occasioned by friction, and leakage due to imperfect insulation, it will perhaps be much more economical to transport the fuel gas rather than the electricity, particularly as the gas plants will have to be moved from time to time, or the coal supplies fail, in order to obviate transportation charges.

The time is not far in the future when great cities like New York will be giving as much thought to the supply of their fuel gas requirements as they now do to the water supply, and with quite as much reason.

Let all such interests be controlled directly and entirely by the city as a safeguard against one of the greatest possibilities of monopoly known to modern times. Surely a city's heat, light, and power are too vital in their connection with the common welfare to be intrusted to private corporations.

A city could easily secure for public use vast coal fields, even hundreds of miles away, convert the coal into gas at the mine, convey it to its corporate limits, distribute it at reasonable rates to consumers in its factories and homes, and thereby give an incalculable impetus to its own industrial, commercial, and social advancement. J. LOGAN IRVIN.

Americus, Ga.

HIGH-POTENTIAL DISCHARGES.

BY A. FREDERICK COLLINS.

The various manifestations of high-frequency and high-potential discharges offer a fertile field of research, especially for the amateur investigator, since it is a subject that has received comparatively little attention considering its significance as revealed in its recent applications to electrotherapy, radiography, and wireless telegraphy.

LIGHTING AN INCANDESCENT LAMP SHORT-CIRCUITED WITH HEAVY COPPER.

The current has the choice of two paths—an easy one through the copper bar and a path of higher resistance through the lamp—and it chooses the latter. Ordinary currents would take the easier path.

The term "electric discharge" is understood to include all modes of equalization of differences of potential between the terminals of a source of electrical energy on their connection by a conductor, by the removal of their charges by a stream of electrical particles of air, or by a sudden discharge that breaks down the air or other intervening dielectric. These are the three chief methods of restoring the electrical equilibrium, and are known respectively as the conductive, the connective, and the disruptive discharge.

The various forms may be further subdivided into alternating, arc, brush, brush and spray, dead-beat, flaming, glowing, lateral, oscillating, periodic, streaming, stratified, impulsive, and periodic discharges, and these may be produced by utilizing a source of direct or alternating current of low voltage, as for instance a commercial generator; a high-potential apparatus as an induction coil, or a high-potential, high-frequency arrangement, as a Tesla coil, depending upon the requirements of the various cases.

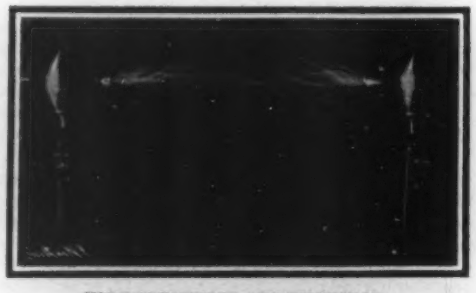
In this review we are concerned only with disruptive and connective discharges, the former in its application to wireless telegraphy and the latter in its relation to the human body. Since only potentials such as can be obtained with an ordinary induction coil are needed for disruptive discharges, these will be described first.

In the production of a discharge of this nature there are two diametrically opposite conditions involved, the first representing an oscillator and spark-gap in an unenergized and non-conductive state, and the second when it is energized and rendered highly conductive, thus completing the circuit. To bring about this result the arms of the oscillator are charged with high-potential energy impressed upon them, which is set up in the secondary of the coil in the form of currents. This kinetic energy is then converted into electrostatic energy, and when the static charge is maximum for a given resistance offered by the dielectric between the surfaces of the spark-gap electrodes heat is evolved in consequence, and when a certain critical temperature is reached the positive electrode volatilizes, and it is this effect that forms the initiative in breaking down the dielectric of the spark-gap.

The law relating to the heat evolved states that it is proportional to the square of the charging current and to the resistance of the dielectric between the positive and negative electrodes forming the boundaries of the spark-gap. The energy that is emitted from the positive electrode is proportional to the potential difference impressed on the oscillator system and the specific inductive capacity, while it is inversely as the distance separating the spark-gap electrodes. The length of the spark that passes depends also largely on the following factors, namely, the difference of potential between them, the character of the medium that separates them, and on the density or pressure of the dielectric through which the discharge passes.

A decrease in the pressure of the medium serves to increase the distance through which a spark will pass, but a point is quickly reached wherein a further decrease has the effect of cutting down the length of the spark, and hence where a low vacuum will permit the passage of high-potential currents over longer distances than in air, a high vacuum retards them even though the potential may be considerably increased. Then again the metal of which the electrodes are made determines the sparking capacity to a certain appreciable extent since some retard and others assist the process of volatilization, and finally the size and shape of the spark-gap-electrodes also have their effect upon the discharges.

From these considerations it will be observed that when the electrodes are placed closely together the strength of the charging current is increased, and hence the heat developed causes the temperature to rise. When the sparking distance is greater than the maximum difference of potential can easily break down, a faintly luminous discharge will be seen issuing from the positive electrode, especially if it should present any sharp points. This phenomenon occurs in virtue of the fact that metallic points are more easily heated than those in the form of spheres.



HIGH-FREQUENCY ARC DISCHARGE.

HIGH-FREQUENCY STREAMING DISCHARGE.

When the charge and temperature reach a critical value a conducting microscopic thread of gaseous vapor is developed and this is attracted to the negative electrode, to which it passes by the path of the least resistance. When this filament bridges the gap its diameter is very greatly increased, the resistance that was previously enormously high becomes minimum, and the current surges forth and back until the energy of the system is damped out by the sum of the resistances.

While Tesla was not the first to produce the varied and beautiful forms of convective discharges he was probably the first to systematically investigate them. Though convective discharges may be frequently observed from a pointed positive electrode of an induction coil, they are much more intense and brilliant when the potential and frequency of the oscillations are stepped up by means of a secondary transformer.

The compact apparatus for obtaining high-frequency and high-potential discharges shown in the illustrations was designed by Prof. Ovington, who repeated many of Tesla's experiments and introduced several new ones during the recent electrical exhibition at the Madison Square Garden.

With high potentials and high frequencies the electrostatic field is collapsed more easily than when those of lower value are reached, while the oscillations increase the temperature developed by the transition of static into kinetic energy and for this reason the volume of vapor is increased and an arc discharge results.

The flaming and streaming discharges which are forms of the connective discharge are closely allied and occur when the frequency and potential is increased beyond a certain value; under these conditions the discharge assumes definite characteristics wholly different from those of the disruptive discharge. In these forms of discharge the energy passes between the electrodes as luminous streams. Such discharges obtained with high-frequency coils are different from those obtained with electrostatic machines, as they lack in the violet color developed by the positive static electrode as well as the bright glow of the negative electrode.

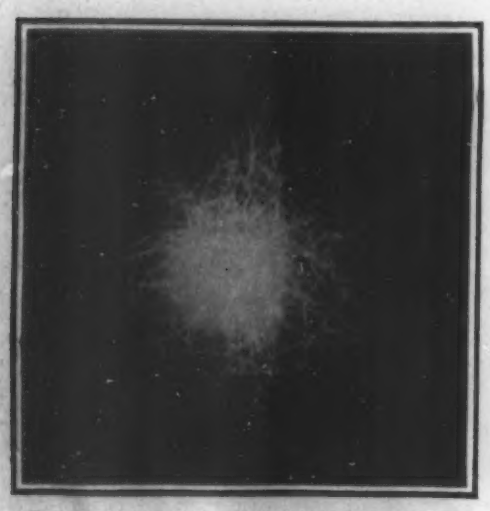
BURNING PLATINUM WIRE WITH CURRENTS PASSING THROUGH THE BODY.

A platinum wire is held in the fingers and near one terminal of the machine. The spark jumps to the body and through the wire.

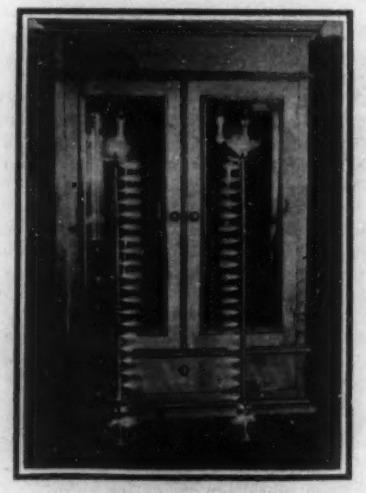
When the frequency and potential necessary to produce the flaming and streaming discharges is increased new phenomena result and a brush and spray discharge is obtained. With suitable electrodes comprising a large number of small points the emanations resemble jets from a gas-flame escaping under high pressure. According to Tesla "they not only resemble but they are veritable flames, for they are hot. Certainly they are not as hot as a flame of gas, but they would be so if the frequency and potential would be sufficiently high."

If the frequency and potential is further increased, the discharge will pass through several inches of solid glass. Ordinarily glass is an insulator of electricity, and yet in this case the streams flow through it apparently with the greatest freedom. The flow of luminous energy has a tendency to stream out and to be dissipated to such an extent that when the brush is produced at the positive electrode no disruptive discharges will occur, even though the hand or any conducting object is held within the stream, and what is even more singular, the luminous stream is not at all easily deflected from its path by the approach of a conducting body.

Under these remarkable conditions the energy loses its property of producing sensation when it comes in contact with or passes through the human body, and a person may now be connected with the source of high-potential and high-frequency currents and be completely charged, though he will feel nothing; that he is a portion of an oscillator, however, can be readily determined, for if a vacuum tube is brought near any part of his body it will glow due to the electric waves emanating from him. To illustrate how absolutely devoid the sensory nerves are to these currents, a



THE AUTOGRAPH OF AN ELECTRIC SPARK, WRITTEN ON A PHOTOGRAPHIC PLATE.



ELECTRIC TESTS.

The current issues at an enormous voltage from a large number of small points, so that it seems like jets of burning gas escaping at high pressure.

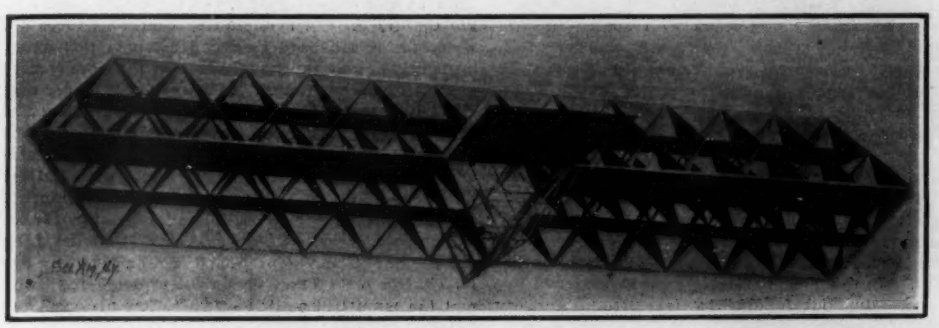
vacuum tube may be held in the mouth, and a current passed through the lamp lights it and then continues on its course, passing through the membranes of the mouth, which are perhaps the most sensitive of any in the body, yet no sensation whatever is experienced. A half-dozen incandescent lamps may be lighted with current passing through the body and no sensation is felt although instant death would result were the rate of oscillation reduced within certain limits.

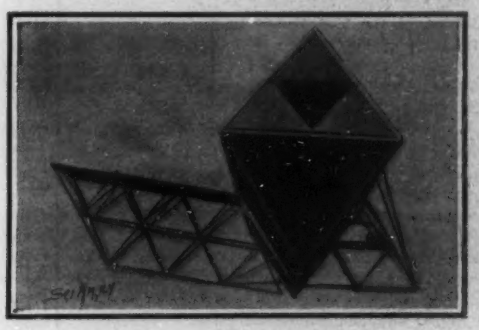
To show the impedance a copper bar of large diameter offers to a high-frequency current, an incandescent lamp is short-circuited across the former and the current is thus given the choice of two paths, an apparently easy one of small ohmic resistance and high impedance through the copper rod, or a seemingly more difficult one of large ohmic resistance and low impedance through the lamp. While an ordinary current would of course choose the former, the extraordinary current traverses the latter path.

The practical application of these discharges is found in radiotherapy. Their use is being extended more and more, and by many it is considered a rational method in therapeutic practice. Heat, light, and electricity when properly applied have accomplished surprising results. With the apparatus shown not only are all the various remedial manipulations of electricity available, but current is also supplied suitable for producing the X-rays, ultra-violet light, etc.

THE AERO CLUB OF AMERICA'S EXHIBIT OF AERONAUTICAL APPARATUS.

A most interesting exhibit, in connection with the Sixth Annual Automobile Show held recently in the 69th Regiment Armory, was that made by the newly-formed Aero Club of America. This exhibit was the most complete of its kind ever held in any part of the world, for all types of flying machines, balloons, and airships were represented. In the same room with Santos-Dumont's No. 9 airship was to be seen one of the original gliding machines of Herr Otto Lilienthal, as well as the gasoline and steam-propelled aerodromes of Prof. Langley and the motor-driven aeroplane models of Herring and Hargrave. Other apparatus shown consisted of Prof. Bell's tetrahedral kite, Ludlow's combined box kite and aeroplane, Myer's electrical torpedo, and Kimball's heliocoptere. The original Hargrave box kite was also shown, as well as numerous models designed by Herring and Chanute. Besides these very complete exhibits of apparatus, the walls of the room were covered with a large collection of photographs showing the machines of other inventors, such as Whitehead, Berliner, and Santos-Dumont; and other photographs showing airships and balloons in flight, together with bird's-eye views taken from the same. In another room cinematograph exhibitions were given twice every day. The views shown consisted of motion pictures of the Vanderbilt automobile race, the Mount Washington hill climb, balloon ascensions, and experiments in raising aeroplanes when towing them by means of a motor boat. In showcases placed in the exhibition hall were seen primitive models of flying machines from the Patent Office at Washington, light motors and other appliances for aeronautical work, together with a collection of books bearing on the subject. Among the exhibits of apparatus of historic interest were the large wood propellers which Mr. Her-

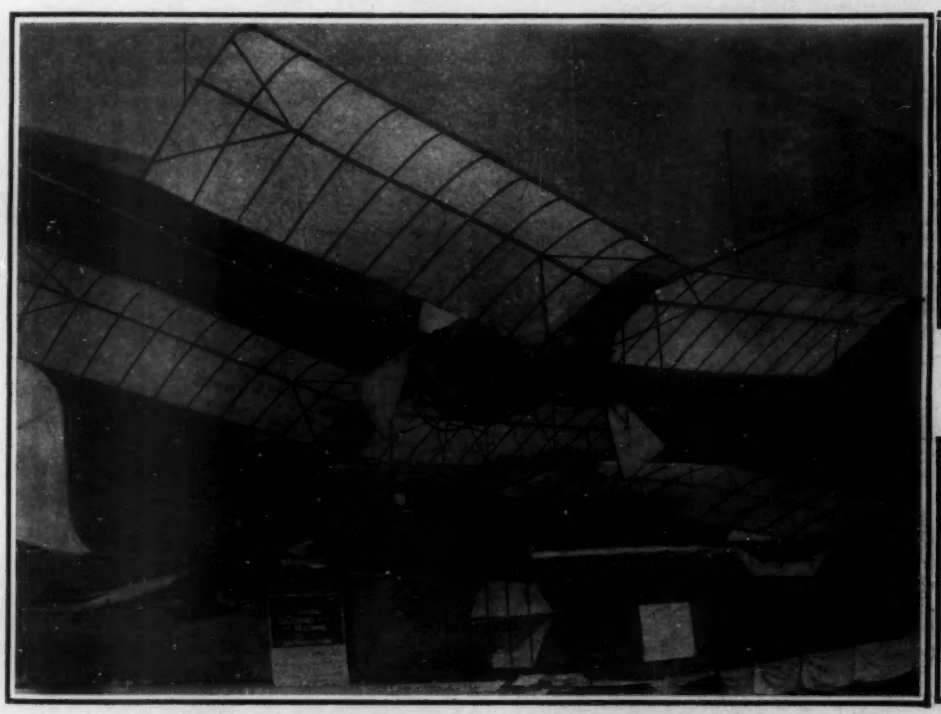




Side and End Views of Prof. Bell's Tetrahedral Kite, Which, When It is Released in Mid-Air, Descends in a Series of Curves, and Sometimes Describes a Complete Circle Like a Soaring Bird.

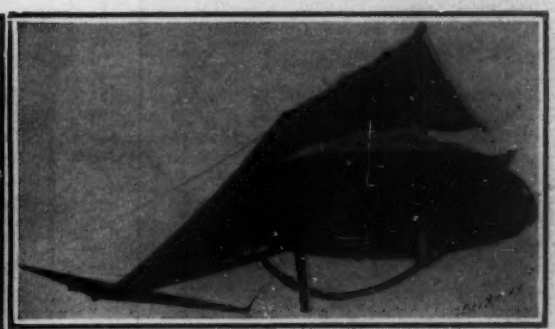
This photograph shows the rear of kite, which is made up of tetrahedral cells constructed of spruce sticks 4 mm. (0.157 inch) square and 25 cm. (9.842 inches) long, bound together with fine twine and covered with red silk. The weight of a single cell is 9½ grms., or ⅓ of an ounce.

This view shows the tail tipped upward, which is accomplished automatically by a pendulum in the bow when the kite makes a dive.



Langley's Steam Aerodrome—the First Power-Driven Aeroplane to Fly.

The first successful flight of this machine was at Quantico, Va., on May 6, 1896. The rudder at the left of this picture forms part of Lilienthal's gliding machine. In the right-hand corner of the room is seen the Herring-Arnot two-surface aeroplane which has been used successfully by Mr. Herring and the Wright brothers.

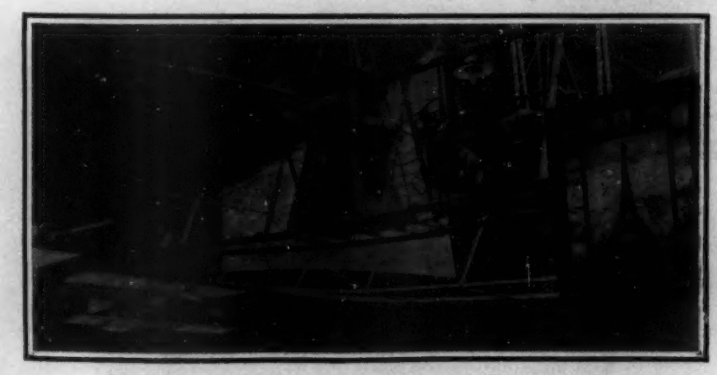


Herring's Dome Kite of 1896.

With this kite the center of pressure is almost constant with widely varying angles of inclination. Its lifting power is also high.

Samples of Brown's Bi-Planes.

This type of aeroplane consisting of two following surfaces was invented about 1878. Langley's aerodrome was built on this plan. But 20 pounds per horse power can be lifted with this type of machine where from 100 to 150 pounds per horse power can be lifted with the superposed plane type.



The Motor and Basket of Santos-Dumont's No. 9 Airship.

A blower is arranged to blow on the motor cylinders to cool them properly. A large bicycle wheel acts as a flywheel and the shaft carrying the propeller runs forward to the front of the framework. The model two-surface aeroplane in left-hand corner is a motor-driven model which is said to have made numerous successful free flights.

One of the Original Lilienthal Gliding Machines with Which He Made Hundreds of Successful Flights.

This machine has a rudder, which is shown in the view of Langley's aerodrome. Lilienthal succeeded in steering in a sharp curve to right or left with this machine.

INTERESTING EXHIBITS AT THE AERO CLUB'S EXHIBITION.

ring used on the first motor-driven, man-carrying aeroplane to make a flight from the ground. This machine, according to Mr. Herring, was propelled by a small compressed-air motor. On October 22, 1898, he informs us that it flew with its operator a distance of 72 feet in 8 seconds against a 25-mile-an-hour wind. Another exhibit of great interest at the present time, in view of the claims of remarkable flights made by the Wright brothers last summer, was the four-throw crankshaft and flywheel of the motor said to have been used on their machine when, on December 17, 1903, they made their first flight with a motor-driven aeroplane at Kitty Hawk, N. C. These experimenters claim to be using the same cylinders with their latest machine, the motor of which they have fitted with a lighter crankshaft. The crankshaft shown weighed in the neighborhood of 30 pounds.

Among the model self-propelled aeroplanes shown, those of Prof. Langley should undoubtedly have first mention. The steam-driven machine flew about half a mile over the Potomac River at Quantico, Va., a little less than ten years ago, or on May 6, 1896. This was the first flight of a motor-driven aeroplane. The gasoline-propelled model (which has a five-cylinder air-cooled motor, the cylinders being arranged in a circle) made numerous shorter flights in August, 1903. Prof. Langley's models are constructed on the following plane principle. The original inventor of this device, which was first brought out about 1878, was Mr. Brown, and samples of Brown's "bi-planes," as they are termed, are shown on page 93. A lift of only about 20 pounds to the horse-power is possible with this system, as against a lift of from 100 to 150 pounds per horse-power with the superposed plane type. In actual practice Langley obtained about 18 pounds lift. Langley's complete steam machine weighed 30 pounds, while the motive plant developed 11.4 H. H. P. The gasoline model was one-quarter the size and one-sixteenth the weight of Langley's man-carrying machine. It weighed 58 pounds, of which 10 pounds was in the 10 horse-power engine. As to the actual flights of these machines, there can be no question, for the one on the date mentioned was witnessed by Prof. Bell, and photographs were taken of the machine in flight.

Another interesting model is that exhibited by Mr. Herring, and which he claims has made numerous successful flights. When tethered to a high pole with a long cord, this machine is said to have flown 15 miles in a circle in December, 1902, and to have stopped only when the gasoline supply gave out. A single-cylinder, air-cooled gasoline motor having mechanically-operated inlet and exhaust valves and a make-and-break igniter, all worked from a single cam, and carrying a small propeller on its crankshaft, was shown on this machine. The weight of the motor was said to be only 2 pounds, and its maximum horse-power 0.51 at 3,400 R. P. M. In flight, however, the engine only made about 850 R. P. M. and developed but 0.07 horse-power. The aeroplanes of this model (which is shown in the lower left-hand picture on the preceding page) were 5¼ feet long by 14 inches wide, and the 19-inch propeller which was fitted drew them through the air at a speed of about 30 miles an hour. This machine is of the usual rectangular, curved, superposed plane type invented by Chanute and Herring about the year 1896. Its successful operation is said to be due to an equilibrium-maintaining device which its inventor prefers to keep secret. No photographs of this or of larger man-carrying machines in flight were shown, nor has any trustworthy account of their reported achievements ever been published. A single blurred photograph of a large birdlike machine propelled by compressed air, and which was constructed by Whitehead in 1901, was the only other photograph besides that of Langley's machines of a motor-driven aeroplane in successful flight. In order at least partially to substantiate their claims, it would seem as if aeroplane inventors would show photographs of their machines in flight. This has been done by Mr. Maxim and Prof. Langley; and on account of his desire to secure photographs of his tetrahedral kites in mid-air, Prof. Bell uses red silk in their construction instead of nainsook, which he prefers, but which, owing to its light color, is difficult to photograph.

In contrast to the great secrecy of the later aeroplane experimenters, should be noted the free manner in which that first great experimenter in gliding flight, Otto Lilienthal, gave the results of his experiments to the world. One of the early gliding machines used by him in 1893 was exhibited, and a photograph of this machine is to be seen on page 93. Had it not been for his untimely death in 1896, from the breakage of his machine while in flight, there is scarcely any doubt that he would have solved the problem of the motor-driven aeroplane some years ago; for he was not only a thorough mathematician and physicist, a clever constructor and mechanical engineer, but he was also possessed of that daring and physical dexterity which is a valuable aid to one attempting to solve such a problem.

One of the most interesting exhibits was Prof. Bell's tetrahedral kite shown on the preceding page, and a 408-cell model of the huge 1,300-cell man-carrying kite "Frost King," which was fully described in Supplement No. 1432, and which carried over 280 pounds. Despite the apparent frail structure of these tetrahedral cells, their great strength when assembled was demonstrated by the placing of a 190-pound man upon a mass of 100 or more without damage. The kite we illustrate, by means of its tipping tail worked by a pendulum in the bow, will descend in long graceful curves when released in mid-air, and several times it has described complete circles before alighting, in much the same manner as does a soaring bird.

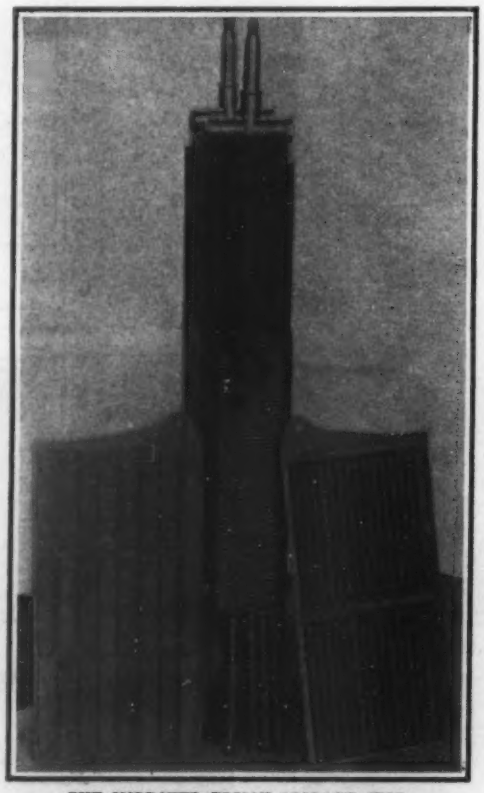
Among other interesting exhibits were examples of balloon wicker baskets equipped with appliances for sketching and photographing the country, and for making weather observations. The frames of two dirigible balloons, the "Santos-Dumont No. 9" and "The California Arrow," were exhibited. Both were equipped with air-cooled gasoline motors of the lightest construction.

A complete set of apparatus used by the weather bureau formed still another extremely interesting exhibit.

The greatest credit should be given to the Committee of the Aero Club, and especially to its able secretary, Mr. Augustus Post, for the exhibit made at the Armory. Not only will this exhibit tend to stimulate interest in the art of flying, but, followed by the active interest of the Club in matters pertaining to the art, it should greatly promote the development and perfection of the practical flying machine.

CHANGES AND IMPROVEMENTS IN THE EDISON NICKEL-IRON STORAGE CELL.

The illustration shown herewith makes apparent the changes in construction of the nickel, or negative plate,



THE IMPROVED EDISON STORAGE CELL.

Note the tubes for holding the active material of the nickel plate now used in place of the flat briquettes, which are still used in the iron plate. The seam where the jar is electrically welded is seen at left of the fluting. The plates are set in hard rubber frames and separated by small square strips.

of the Edison alkaline storage cell. Actual use of some 175 sets of automobile batteries has demonstrated that there is a loss in capacity, due to the separation of the active material from the containing flat cases of the nickel plate. A new form of briquette, consisting of a rolled tube of perforated, nickel-plated, sheet steel, is soon to be used. These tubes are tightly packed with active material by a special machine, and they are then clamped into place in the plate by means of their twisted ends. The tubes are made from a small sheet of metal, which is rolled into the tubular shape and has its two ends joined together. Thus there is a joint running the entire length of each tube, but by twisting the ends of the tube and clamping them, it is impossible for any appreciable expansion of the latter to occur, and separate it from the active material within. A new form of binder other than flake graphite has been discovered, and this, together with the new construction, is said to increase the total capacity of the cell from 10 to about 15 watt-hours per pound of complete cell. A 21 per cent solution of caustic potash is used in these cells, and three sizes are made, the smallest having a capacity of 110 ampere hours at a 30-ampere rate, and requiring 150 ampere hours to recharge it. The improvement in capacity will place the Edison cell at the head of the list for lightness. Regarding its durability, Mr. Edison believes the new plates will last for four years at least in actual service, and that they can then be renewed for about one-third their first cost.

Electrical Notes.

According to the latest news which we receive concerning the electric installations in Japan, we find that all the cities whose population is above 10,000 inhabitants are lighted by electricity, and besides many of the towns are now equipped with electric tramway lines on the trolley system. Owing to the fact that the country is of a mountainous character, there are waterfalls to be found in abundance, and this naturally contributes to a great extent in the development of electrical enterprises. At present about 30 per cent of all the electric plants are operated by water power. The country is also greatly favored in possessing extensive coal mines, so that the cost of running steam engines is not high. Among the large electrical enterprises of Japan we may mention the Tokio Electric Light Company, which has a station of some 20,000 horse-power capacity at a distance of 20 miles from the capital. The Tokio Electric Power Company has an electric plant of no less than 40,000 horse-power, and the municipal station of Tokio has a capacity of 2,500 horse-power. At Osaka, which is one of the leading commercial cities, there are several electric stations already running. One of the recent projects to be carried out by the Uji River Hydro-electric Company relates to installing a water power plant at 20 miles from Osaka, and it will use upward of 35,000 horse-power.

According to recent information relating to the Jungfrau electric road, the tunnel which ends at the Mer de Glace was finished about the middle of June. At present, the stations of the line comprise the starting point at Petite Scheidegg (6,710 feet altitude), the second station of Eiger Glacier (7,550 feet altitude), third, Rotstock (8,220 feet), Eigerwand (9,330 feet), and lastly the Mer de Glace (10,280 feet altitude). The service of the road is assured by six electric locomotives of the three-phase type, of which three have been built by the Brown-Boveri Company and the remainder by the Oerlikon Company, both of Switzerland. The current for the road, which takes 7,000 volts primary tension and 500 secondary, comes from the large hydraulic plant of Lauterbrunnen. A fall on the Lutschine River furnishes some 2,500 horse-power to the turbine. According to Guyer and Zeller's project the new part of the electric road, which remains to be built, is to run in a straight line toward the west and rise on a low grade to the station of Jungfrauenjoch (11,058 feet altitude). From there it will reach the Jungfrau station which is to be cut in the rock. This latter station will be equipped with an electric elevator which is to run up to the highest point of the mountain and lies at an altitude of 13,545 feet.

Our readers will doubtless remember the description of an improved and simplified type-setting telegraph apparatus called "teletyper" (*Ferndrucker*) we published in these columns some time ago. We learn from an article in the Elektrotechnischer Anzeiger that after a central station had been installed two years ago to enable subscribers to the novel system to communicate with each other as well as with the Wolff telegraph office and other information bureaus, the same service is to be utilized now for general telegraphic purposes. The imperial postal department has in fact ordered a set of teletypers to be used in connection with Berlin intra-urban telegraphy. The practice so far usual in connection with urban telegrams was to convey these through a network of pneumatic tubes. Though the speed of pneumatic dispatch carts, equal to that of express trains, be considerable, this means of conveyance of the records still requires a certain amount of time. The pneumatic tubes radiate toward the telegraph office, where they are combined. Though immediate connections between the various stations be available, there was the necessity of shifting the telegraph records. The adoption of teletypers will doubtless accelerate the dispatch of telegrams. A new exchange is to be installed for this purpose in connection with the central telegraph office. All the pneumatic dispatch offices are to be equipped with a teletyper and to be connected immediately to the central telegraph office. It may be mentioned that the number of these offices amounts to 67. The teletypers are intended for the beginning to convey the intra-urban telegrams which are largely used in Berlin. Practice will show in how far this scheme would be available also for the conveyance of outside telegrams from and to the central telegraph office. Like the telephone, the teletypers can communicate immediately with each other, while capable of simultaneous communication with the same station, whence the same telegram can be transmitted to all of them. As the record is obtained simultaneously in both the transmitting and receiving apparatus, there is every facility of checking its correctness. The main advantage of the teletyper is, however, its ease of manipulation, requiring but little skill.

THE "ROMAN ORDNANCE" AT THE SAALBURG.

BY PROF. RUDOLF SCHNEIDER.

For many years the German government has been carrying on a systematic exploration of the ruined fortifications along the line of the Roman military frontier (*limes imperii Romani*), extending from the Danube near Regensburg to the Rhine near Neuwied, a distance of 340 miles. The work received a new impetus a few years ago when the Kaiser ordered the restoration of the best preserved fort, the Saalburg on the Taunus ridge near Frankfurt, in order that it might serve at once as a model of a Roman fortress and as a museum for antique objects of interest discovered in the course of the explorations. In 1904 there were mounted at this re-built Roman fortress three pieces of "Roman ordnance" which fully deserve their post of honor although they are neither Roman nor ancient, and were not found on the old Roman frontier. They are reconstructions made by Major Schramm in accordance with ancient descriptions. They are not mere show pieces but practical engines of war, as appears from the following record of their performances in practical trials.

One of the pieces, the "euthytonon" (Fig. 5) shot a dart about three feet long to a distance of 1,200 feet and drove it through an iron-plated shield more than an inch thick with such force that it projected half its length behind the shield, so that it would have killed or disabled a human shield bearer. Another piece, the "palintonon" (Fig. 4) hurled a stone weighing two pounds to a distance of 600 feet, and a one-pound leaden bullet 1,000 feet. The third piece, the "onager" (Fig. 3), threw a one-pound leaden bullet 460 feet.

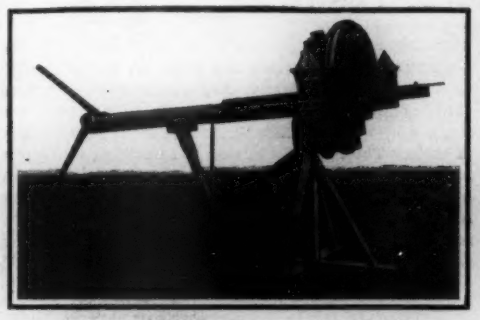


Fig. 5.—Euthytonon, Reconstructed by Major Schramm.

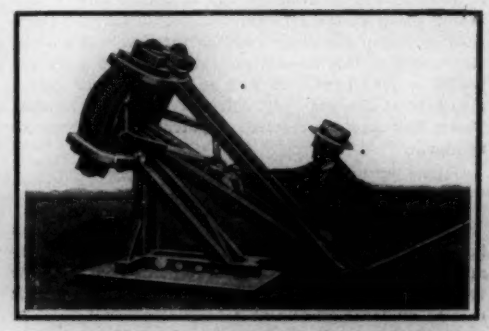


Fig. 4.—Palintonon or Mortar.—Major Schramm's Restoration.

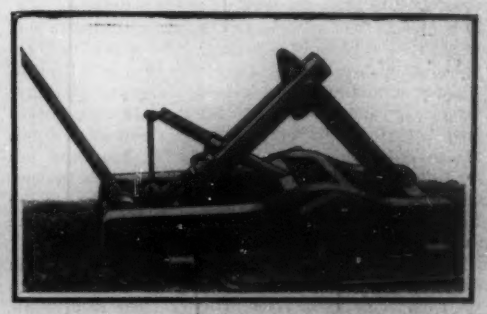


Fig. 3.—The Onager or Machine-Sling, as Restored by Major Schramm.

These results, which far surpass the achievements of the earliest cannon, are the more surprising because similar experiments, made in 1865, were little better than flat failures, owing chiefly, as Major Schramm has pointed out, to defective construction of the apparatus. About the same time, the Emperor Napoleon III. had some "ancient artillery" constructed, which is still to be seen in the museum at St. Germain. But illness and political cares diverted Napoleon's interest from the subject and no authentic record exists of the performance of these pieces. In order to understand ancient ordnance it is necessary first to get rid of the common and erroneous notion that it consisted, essentially, of huge arbalests or cross-bows. As a matter of fact it was based on a very different principle. The propulsive force of the cross-bow is furnished, chiefly, by the elasticity of the arms of the bow which, bent backward by pulling the cord, spring forward when this is released, carrying with them the cord, which transmits the impulse to the "quarrel," or dart, laid in front of its middle point. The ancient ordnance, on the contrary, had rigid, inelastic arms, moved by the torsional elasticity of bundles of animal sinews which, however, were sometimes replaced by horsehair or even, in protracted sieges, by the long tresses of women. The Roman writers grouped all of these "catapults," as we commonly call them, under the generic name *tormentum*, which means a torsion machine, and applied the names *catapulta*, *ballista*, *scorpio*, etc., to the different varieties rather loosely, and without clear distinction. The tormentum, then, was not a mere improvement of the cross-bow but an entirely new device. Diodorus Siculus ascribes its invention, probably erroneously, to certain eminent mechanical engineers whom Dionysius, in 400 B. C., summoned to Syracuse from all lands to aid him in preparing to make war on Carthage. It is a significant fact that some of these men were Carthaginians, for Pliny speaks of the catapult as a Phœnician invention, and such machines are mentioned in the Old Testament as in use not only in the second century B. C. (I. Macc. 6.51) but even in the eighth century B. C. (II. Chron. 26.15). It seems not unlikely, therefore, that the Greeks merely adopted and perfected an ancient device of Oriental invention.

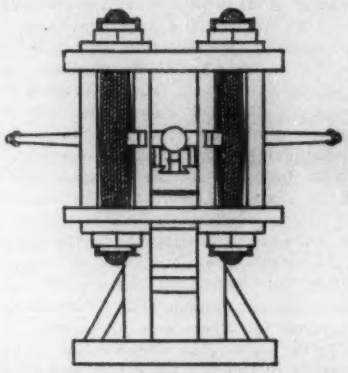


Fig. 2.—Major Schramm's Conception of the Palintonon.

The principle of the tormentum is well illustrated by a common toy, made as follows: Two holes are bored in a half walnut shell, near the edge and opposite each other. A horsehair is threaded through the holes, back and forth, making at each passage a turn around a bit of hair pin laid over each hole, on the outside of the shell, and the ends of the horsehair are fastened until the twisted multiple match stick is tightly hair and turnthe middle of strands are loop of horsetogether. Now, if the stick is withdrawn a little way and suddenly released, its longer end flies around and strikes sharply on the edge of the nutshell, producing a loud sound pleasing to youthful ears.

This plaything, if constructed on a larger scale of stronger materials, with a sling attached to the free end of the stick, would fairly represent the simplest form of tormentum, the onager, or machine sling (Fig. 3). This machine was employed to hurl great stones against walls and towers for the purpose of shattering them or making a breach. The base of the onager is formed of two parallel heavy timbers, joined by cross-pieces at their ends and pierced in the middle by holes through which the bundle of fibers passes, to wrap around pins outside, precisely as in the nutshell snapper. From the center of the bundle of fibers, which tightly fill the holes, rises obliquely a stout wooden arm ending in a hook from which a sling, carrying a stone, is suspended. When this arm is drawn down into a horizontal position by means of a winch, and suddenly released, it springs forward and upward in obedience to the torque of the twisted bundle of sinews until it is stopped by striking against a buffer, whereupon the stone leaves the sling and flies onward toward its goal. Ancient writers use the most extravagant expressions in describing the power of the onager, and it may be inferred that its dimensions greatly exceeded those of the reconstruction at the Saalburg. The same conclusion is suggested by a curious passage, the correct interpretation of which has been reserved for Major Schramm. Ammianus says that the onager was placed on a bed of turf or bricks (that is, on a soft or yielding foundation) because if it were placed on a masonry wall (which is rigid) the wall would be shattered, not by the weight of the machine but by the violent shock (of the recoil). Even in Major Schramm's reconstruction the initial longitudinal tension of the bundle of fibers is twelve tons.

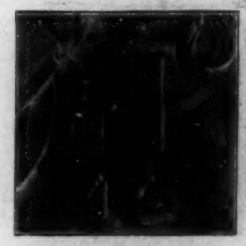


Fig. 7.—Tormentum from Trajan's Column.

Fig. 6.—Palintonon Carved on the Tombstone of a Roman Artillery Captain.

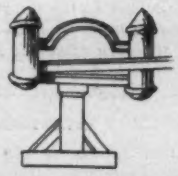


Fig. 8.—Aerotonon or Air Gun from Trajan's Column.

Far more ingenious than this machine sling, though based on the same general principle, are the two other tormenta, each of which has two parallel bundles of torsion fibers and two revolving arms, and resembles a cross-bow in its action, though not in its construction or motive power. In the onager, as we have seen, the torsion fibers are horizontal and the arm moves in a vertical plane. In the palintonon, on the other hand, the fibers as well as the plane of rotation of the arms, which is necessarily perpendicular to the fibers, are sharply inclined, and in the euthytonon the arms move in an almost horizontal plane, while the fibers are nearly vertical. In each of these machines the free ends of the arms are connected by a cord. When the middle of this cord is drawn back the arms, which at first diverge widely, are pulled together and the two bundles of fiber are, consequently, twisted in opposite directions. Then, when the cord is released, the arms spring apart, carrying forward the cord and, before it, the projectile, which proceeds freely on its course when the arms are arrested by the stops.

In the construction of these two-armed catapults Major Schramm followed the descriptions and dimensions given by the Greek writers Hero and Philo, who lived in the third century B. C., and by the Roman Vitruvius, who in the reign of Augustus translated and supplemented their works. Here a difficulty was encountered. The ancient writers distinguished two varieties of tormentum by name without clearly indicating their differences, concerning which diverse opinions have been held by modern commentators. Major Schramm has decided, on both technical and etymological grounds, that the euthytonon was a direct-firing weapon analogous in function to our rifled cannon, while the heavier palintonon was designed, like our mortars, to throw large projectiles over walls and

Fig. 1.—Three Roman Pieces of Ordnance (Euthytonon, Palintonon, Onager.)

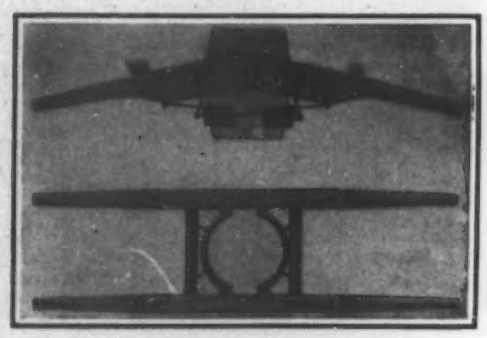
other obstacles. The Saalburg reconstructions were built and mounted in accordance with this view, as is clearly shown by the accompanying illustrations. As each bundle of fibers has an initial tension of twelve tons, these two-armed machines are, in a sense, twice as powerful as the reconstructed onager.

Major Schramm's work has had a very interesting sequel. When pictures of the reconstructed ordnance reached Prof. Hülsen in Rome, they immediately re-

A NOVEL GUN ATTACHMENT.

minded him of a relief carving on a tombstone found there in 1826 and now in the Vatican museum, which had been supposed to represent either a lock or a surveyor's level. The striking resemblance of this relief (Fig. 6) to Schramm's drawing of his palintonon (Fig. 2) proves beyond a doubt that it was intended to represent such a piece of ordnance. This was a very appropriate device, for the tomb was that of a Roman captain of artillery, who served under the emperors Vespasian and Domitian. Similar representations have been found on Trajan's column and on the Pergamon relief, now in Berlin (Fig. 7), but these are far inferior to the one on the tombstone of the Roman officer, which was probably executed, according to the Roman custom, before his death and under his expert supervision.

All three of these Saalburg reconstructions, the onager, the palintonon, and the euthytonon, belong to the class of heavy or siege artillery. The field pieces, light enough to be transported by two mules each,



CARRIER FOR BARRELS.

which were used by Trajan in his German wars and are represented on his column (Fig. 8), were of an entirely different character. They were aerotona, or air-guns, and had levers and compression cylinders of metal.—Abstracted for the Scientific American from an article in Umschau.

IMPROVED CARRIER FOR BARRELS.

A simple device has recently been invented for lifting a barrel, or the like, and carrying it from one place to another. The device is admirably adapted to the use of bricklayers, masons, and other mechanics having to carry barrels of sand, cement, and similar materials. The carrier comprises two pairs of handles which are hinged together, the hinge being so constructed that the handles may freely swing downward, but cannot swing upward above horizontal alinement. The members of each pair are spaced apart by a rung. Suspended from each of the rungs, by means of pins passing therethrough, is a pair of links supporting a segmental band. From the extremities of each band-segment connecting rods extend to the opposite handles. The connection is such that when the handles are swung downward the rings are moved apart, but when they are swung upward the band-segments move toward each other, to clamp any object that may be placed between them. In use the handles are swung downward, and the band-segments are slipped over a barrel. Then, to transport the barrel, it is merely necessary to lift up the handles, when the band-segments will grapple the barrel. As a means for enabling the carrier to be raised to any desired height, rings are attached to the handles, to which hoisting cables or chains may be attached. The inventor of this improved carrier is Mr. John Mitchell, Dannemora, N. Y., Box 135.

A NOVEL GUN ATTACHMENT.

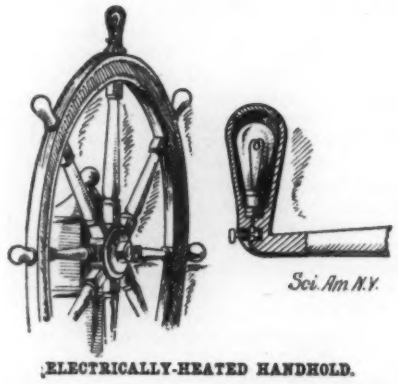
A recent invention provides a handle which may be applied to rifles and shotguns, to facilitate supporting the barrel end of the gun. In aiming a gun in the ordinary way, the palm of the left hand is upward, and in swinging the muzzle of the gun around at different times, the weakest and least used muscles of the arm are employed. Furthermore, the arm is held nearly straight from the wrist to the shoulder, preventing the use of the elbow joint. The improved device gives free use of the elbow joint, and brings into play muscles which are already developed and strengthened, thereby improving the aim of the operator, and relieving him from the fatigue of continually holding his arm in a strained position. The invention also provides a very comfortable and convenient way of carrying the gun, permitting the sportsman to carry it with the muzzle down, and the arm hanging freely at the side. The attachment comprises a clasp adapted to grip the gun barrel, and a depending handle, which projects below the barrel and may be readily grasped by the hand. The clasp consists of two metal plates, curved to embrace the barrel, and formed with depending shanks to which the handle sections are attached. The shanks are separated by a filler piece, and the outer faces of the shanks are covered with wooden sections, the whole being bolted firmly together. In practice the clasp sections may be lined with leather or soft material to prevent scratching the barrels, and if desired the entire handle may be covered with leather to give a proper finish to the same. The clasp may be fixed at any position on the barrel by means of a thumb screw at the forward end, which may be tightened to clamp the clasp sections together. It will be observed that this handle protects the hand from the heated or cold barrel, as well as giving the shooter a firm hold of the gun. Mr. Alfred T. Wight, of Roxton, Texas, has recently received a patent on this gun attachment.

CORN HARVESTER AND HUSKER.

We illustrate in the accompanying engraving a corn harvester and husker invented by Mr. Arthur W. Richards, of Indianola, Iowa. The machine is built to stride two rows of corn. The main body of the machine is carried on large wheels at a height sufficient to clear stalks five feet tall, thus leaving the fodder intact in the field. Inclined spiral reels at the front of the machine are arranged to catch the ears of corn, regardless of their height above the ground. The ears are cut off and fed up to the bed of the machine on an inclined elevator, and are thence carried up with buckets to a table at the top of the machine. A boy at this point slides the ears under a revolving cutter, which cuts off the stem and the curly part of the butt. The ears then pass into the husk shredder. This comprises an upper and lower series of rollers covered with pickers. The lower rollers extend transversely to the upper ones. The ears pass between the sets of rollers, and the husks are shredded off by the pickers. A large fan blows the husks into a screened receptacle. A special feature of the invention is the arrangement of the rollers and pickers. The upper rollers are mounted with sufficient play to allow for ears of different size, and the pickers are longer at the upper end where the corn enters than at the lower end, so that there is no danger of injuring the corn after the husks have been removed.

ODDITIES IN INVENTIONS.

Electrically-Heated Handhold.—In winter weather a motorman's hands are very apt to be numbed by the cold, causing him a great deal of discomfort and also rendering him unable to properly operate the brake and controller handles. The same is true of the pilot of a ship, the chauffeur, or any operator who is exposed to cold. A recent invention provides a very simple remedy for these troubles. The operating handle is made hollow to receive an incandescent electric lamp. At one side is a plug which, on being screwed in, will switch on the current. The heat radiating from the incandescent lamp will warm the handle, giving the motorman a comfortable handhold. As the chamber in the handle is hermetically sealed, all the heat developed by the lamp is given up to the handle, so that the operator is sure of having his hands comfortable, even in the coldest weather. The handhold will also aid in keeping the operator warm, as the palm of the hand is a large nerve center. It is obvious that instead of a lamp, a resistance coil would give equally



ELECTRICALLY-HEATED HANDHOLD.

good results. One of the figures in the illustration shows the improved handhold applied to a pilot wheel. In such case the switch or contact plug is located at the hub of the wheel where it serves to control all the lamps at once.

Adjustable Head for Golf Clubs.—Pictured in the accompanying illustration is a golf club provided with an adjustable head which may be set at any desired angle relatively to the shaft, so as to provide in a single club all the different striking faces of a number of clubs. The head of the club is formed of two parts, namely, the socket piece, in which the handle or stick is fixed, and the blade or striking face. The former is formed with a sleeve which extends at an angle into a socket in the blade. Teeth are formed on the sleeve

ADJUSTABLE HEAD FOR GOLF CLUBS.

which mesh with teeth in the socket, as shown in the small detail view, which is a section of the club head, taken along the dot-and-dash line. This toothed engagement of the parts prevents the blade from turning relatively to the sleeve. A bolt passes through the sleeve and is threaded into the body of the blade. The bore of the sleeve at the upper end is widened to admit the head of the bolt. A spring catch is provided at the base of the sleeve which fits under the head of the bolt, drawing the blade snugly onto the sleeve. When it is desired to change the angle of the blade this catch is depressed, releasing the bolt and permitting the blade to be withdrawn sufficiently to clear the teeth on the sleeve. It may then be turned to the desired angle and pressed back onto the sleeve until the catch slips under the bolt head, and makes the blade secure.

CORN HARVESTER AND HUSKER.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ASYMMETRIC CELL.—M. BÜTTNER, Wilmersdorf-Berlin, Germany. The invention relates to electrochemistry, and its object is to provide an electric battery using aluminium electrodes and an electrolyte not liable to corrode the electrode or evaporate quickly, and which electrolyte is capable of raising the resistance of the aluminium when the latter is used as an anode and is effective at high temperatures.

Of Interest to Farmers.

WAGON-UNLOADER.—G. E. JACKSON, Sigourney, Iowa. This invention relates to an apparatus whereby the body of a wagon may be lifted from its running-gear and when lifted its contents be dumped in bulk into a hopper or storage receiver. The object is to provide a device for the purpose stated, which shall not only be adapted to be readily moved, but operated in a simple way, as by the horse-power or team pulling the wagon being unloaded.

POTATO-PLANTER.—W. E. BAKEMAN, Snohomish, Wash. One purpose of this invention is to provide a furrow-opener of box-like construction into which seed-potatoes drop in their passage to the furrow, which opener is so shaped that it does not clog or gather sod in soddy ground and so that it will make a V-furrow, thereby lessening the liability of potatoes rolling or bounding out of place. The machine protects seed from injury, reduces liability of planting to uneven depths, and covers potatoes any depth.

HAY-STACKER.—M. BAGLEY, Cambridge, Neb. The stacker is moved where the stack is to be made. Hay is brought to the stacker by a rake or other means and placed upon the sling. The larger winding-drum is shifted to clutch with the ring, and power applied to the sweep. When the load is elevated sufficiently the ratchet-lever is engaged with the flange teeth and the drum shifted out of engagement with the clutch. The smaller drum is then shifted into engagement with the clutch-ring and the continued motion of the drive-shaft swings the lateral arm right or left, depending upon direction in which the rope encircles the horizontal drum. At times the smaller drum may be clutched with the ring to elevate and swing the load simultaneously. Means provide for unwinding the hoisting-rope.

Of General Interest.

DISPLAY-FORM.—W. F. ALLERT, New York, N. Y. This form is for use in stores, store windows, and other places for displaying dresses and other garments to best advantage, the form being arranged to permit of placing the garment in position on the form while sectional movable members thereof are in a limp position to allow of giving the members, such as the arms, legs, or the like the desired pose and to finally secure the members in the adjusted position to properly display the garment in the desired pose.

SUSPENDERS.—G. D. ASHELMAN, Fargo, N. D. The principal objects of the present invention are to overcome objections to existing forms of suspenders by constructing a device in which the different parts conform to the natural curves of the body and the protruding parts are located largely in depressions instead of being located over muscles and other projections of the body.

SYRINGE.—J. C. BLAIR, Louisville, Ky. This syringe has an important advantage over the old form in which the screw is provided with a spherical or bulbous head, and a washer is applied between the nozzle and the elastic bulb, since in this case the concavo-convex disks are practically parallel and a comparatively large extent of surface of the same is clamped between the disks, so that leakage is impossible.

APPARATUS FOR PURIFYING FOUL WATER.—H. DESRUMAUX, 35 Rue Alphonse de Neuville, Paris, France. This invention refers to apparatus in which the mixture of the foul water with the reagents is produced with exactness and is quickly and completely decanted. It comprises in particular a device for distributing the solutions of reagents, which is very simple in construction and which gives an exact proportionality between the quantities of water and the solutions of the reagents.

LAST.—G. ENGELHARDT, Cassel, and C. F. FÖLSCH, Wernigerode-on-the-Harz, Germany. In this patent the object of the inventors is the provision of a new and improved last having a hinged toe portion to permit it to be set at different angles to the main portion and to the walking-line of the foot to insure the production of an accurate foot covering, such as shoes, boots, stockings, and the like.

BUTTON-HOLE PROTECTOR.—A. GANZENMÜLLER, New York, N. Y. The principal objects of the improvement are to provide means for simultaneously unlocking and opening such protector or door without necessitating manipulation for the operation of more than one handle, lever, or other operating device. Further objects are to provide for efficient locking of the structure, and to provide for securing it in any desired number of open or partly-open positions.

TIME-CONTROLLED LAMP.—T. W. HUNT, Atlanta, Ga. The alarm being set, a plunger is depressed and a slide is moved in until a lug engages the end of a spring. A match is then inserted within the slot in the upper end of a brass tube. The alarm mechanism released, the key rotates, striking the catch, which through its connection with the slide releases the plunger, and the match is driven upwardly through the reduced opening in a tube of smaller diameter than the match head, thus igniting it. A spreader is arranged within the air-tube so that the brass tube is between slits in the spreader's edge. Ignited, the spreader's bent portion deflects the flame outwardly into contact with the wick, thus insuring proper ignition thereof.

EYE-PROTECTOR.—E. MIROVITCH, 53 Rue Notre Dame de Lorette, Paris, France. The object in this instance is to effectually insure protection of eyes against wind and dust and at the same time obtain other advantages calculated to afford greater comfort to the wearer by, on the one hand, constantly maintaining the chambers in which the eyes are inclosed in a hygienic condition, and, on the other hand, affording a field of vision more comformable to the normal conditions of working of the human eye—that is to say, the normal vision.

BLAST-FURNACE.—E. P. MATHEWSON, Anaconda, Mont. One object of this invention is to provide a furnace arranged to render the working of the furnace exceedingly economical in fuel, labor, and water, to allow treatment of large quantities of material at a time, to insure a quick discharge of the molten metal as soon as the latter reaches the bottom of the shaft, and to prevent incrustation at the sides of the shaft.

INDICATOR.—F. P. PFLEGER, El Paso, Texas. The object of this invention is the provision of an indicator more especially designed for use on phonographs, music-boxes, and like instruments and arranged to permit the user of the instrument to quickly adjust the speed-regulating device of the instrument according to the proper time in which a certain piece of music is to be performed.

DISPLAY-FIXTURE.—E. T. PALMENBERG, New York, N. Y. This invention relates to display-fixtures, such as shown and described in the Letters Patent of the United States, formerly granted to Mr. Palmenberg. The object in the present improvement is to provide a fixture having a supporting member adapted to be conveniently moved into a desirable position for properly supporting the goods to be displayed.

Household Utilities.

WINDOW-BLIND SLAT-FASTENER.—M. J. COOGAN, Port Chester, N. Y. In this instance the invention pertains to improvements in window blinds, the object being the provision of a simple and novel means whereby the lower sets of slats will be simultaneously operated and locked in closed position or at any desired opening.

SASH-BALANCE.—H. A. CROMMETT, Patten, Maine. The improvement is most applicable to windows having an upper and a lower sash, one of which may be lowered and the other raised in order to open the window. In one application of the invention the sashes may be arranged so as to balance each other, the slack of cord being taken up by the device. In a second application of the invention independent devices may be used in connection with each sash.

Prime Movers and Their Accessories.

VALVE MECHANISM FOR INTERNAL-COMBUSTION ENGINES.—W. H. SCHOONMAKER, Montclair, N. J. This valve is especially intended as an inlet valve for two-cycle internal-combustion engines; and particularly to be used in connection with a reservoir in which air or a mixture of air and fuel is kept stored under sufficient pressure to give it the necessary mobility through the cylinder and passages leading thereto, and by the provision of two valves, the movement of the fluids may be controlled fully and possibility of back explosions and other disadvantageous results prevented.

AUTOMATIC FRICTION-GOVERNOR IN FLY-WHEELS.—T. L. CUMMINGS, Spencer, Iowa. Mr. Cummings has invented in this instance a new and improved automatic friction-governor in a fly-wheel for threshing-machine self-feeders or for any other machine where it is desired to gage the speed or stop the motion of the machine when the speed falls below that for which it is set.

Railways and Their Accessories.

RAILWAY-TIE.—T. R. HASLEY, Houghton, Mich. The invention pertains to improvements in railway-ties formed of concrete, vitrified clay, or other plastic material that may be molded and have the required hardness and strength, the object being to provide a tie that will be cheap to manufacture, and comparatively light, yet strong, thus rendering it easily handled without danger of breaking.

ANTICREEPING DEVICE.—J. R. LEIGHTY, Cumberland, Md. The device comprises an abutment member which presents a broad surface to the side of a tie and a V-shaped extension for embracing the side edge of a rail flange. In connection with the abutment member a clamp is provided consisting of a bar having upwardly and inwardly extending hooks at its ends, the hook of one end engaging the edge of a rail flange, the opposite hook embracing the extension of the abutment member. In use it is intended that any tendency of the rail to creep will rock and tend to shift the clamp, causing the same to have a gripping engagement with the abutment section and the rail flange.

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HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
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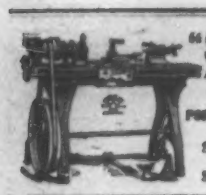
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(9876) J. J. G. asks: Will you kindly explain to me a phenomenon which I have noticed during the eclipse of the sun? At the time the sun is crescent shape, the light falling on the floor after having passed through a window-pane assumes the form of a multitude of crescents. I have never seen an explanation of this phenomenon. I have never seen even an indirect reference to it in any work on physics; but in a work published in 1852 by John Johnston entitled "Johnston's Natural Philosophy," at page 257, in discussing the passing of light through a small aperture a quarter of an inch square, this statement is made: "If these experiments are made during an eclipse of the sun the images will always be of the same form as the disk of the sun toward us." This is the nearest to a reference I have ever noticed. It may be that I have simply overlooked the reference, but it does not take up the question I asked of you, namely, why the light under these circumstances passing through a large glass window will throw thousands of such images on the floor. A. When the light from the sun passes through a small aperture and falls on the floor or any other flat surface nearly or quite perpendicular to the path of the rays of light, the disk seen is circular, since it is an image of the sun. The shape of the aperture through which the light comes does not affect the shape of the disk of light on the screen. The aperture may be triangular, square, round, irregular, or any other shape; the disk of light on the screen is circular when the sun's disk is a circle. The experiment may be performed with a gas burner, a small hole in a cardboard, and a white screen held in the path of the light beyond the cardboard. A very perfect image of the gas flame, inverted, will be found on the screen. The images cast through small apertures are of the same shape as the objects which cast the images. When the sun is in an eclipse the crescent-shaped sun may be seen repeated many times on the ground under trees, or on the floor of a room where the light enters through the crevices between the slats of blinds or other small openings. Ordinarily in the same situations circular disks, images of the sun, are formed. In the case mentioned above, the window must have been rather dusty, so that the window became a series of small apertures in its effect upon the sunlight, and crescent images were seen. We should always see images of the sun on the floor but for the fact that they usually overlap each other. They are always there and may often be distinguished along the edges of a place where sunlight falls on the floor of a room. This matter is rarely mentioned in textbooks of physics now-a-days. The textbooks rarely give interesting applications of principles to occurrences in nature, but limit themselves quite too much to abstract statements of principles. Many textbooks are dry as dust for this reason. The case of images of the sun in an eclipse is to be found in Deschanel's "Natural Philosophy" under "Shadows." It would be a great improvement if all textbooks of science directed the attention of the student more to concrete applications of his study to be seen in nature, often close at hand, as in this particular case.

(9877) J. A. B. asks: 1. What are the underlying principles of cloud electricity, that is, where do the clouds obtain their electrical energy, and how? A. The mode of the production of electricity in the atmosphere is not yet well understood. No theory completely explains all the facts. 2. What is the cause of lightning and thunder? A. Lightning is due to an electric discharge between two oppositely electrified masses of clouds. Thunder is the sound produced by the shock of the air rushing back again into the space through which the lightning has just passed. 3. Why are not all clouds accompanied by lightning? A. All clouds do not produce lightning because they are not highly enough electrified to pierce the air between them and the earth. 4. Do all clouds possess electricity? A. All clouds are electrified, so is the air all the time. 5. Are lightning clouds laden with electricity before there is any lightning flash, or is lightning caused by the friction of the clouds? A. Thunder clouds are more highly electrified than other clouds. Light from the electric discharge is due to the heating of the air through which the lightning flashes. 6. What are clouds? A. Clouds are composed of drops of water in



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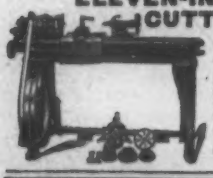

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the air. These drops always fall, as do any other drops, but they may evaporate and disappear before they reach the earth. They may be kept up by currents of air under the clouds, raising them and keeping them from coming through to the earth. Otherwise it would rain every time a cloud passes overhead. 7. Steam circulating in pipes condenses and again becomes water. They why is it that steam escaping into the cold atmosphere rises and finally becomes invisible? Why don't it condense and fall back to the earth in the form of water? A. Clouds are not vapor or steam, but actual drops of water. Steam when it comes out of a pipe and is seen as a cloud is no longer steam but drops of water. If these drops disappear, it is because they evaporate into the air. They often fall as water, wetting the ground below. You would profit by reading some good book on meteorology. Waldo's "Meteorology" is good. We can send it for $1.75 by mail

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THE MODERN WOOD FINISHER. By F. Maire. Chicago: The Western Painter, 1904. 16mo.; pp. 159. Price, 50 cents.

The author has written a series of articles on wood finishing in all its branches. These embody his observations of the practice of wood finishing as it exists in all the leading furniture factories and large paint shops in the country. There exists a great deal of ignorance among the craft of the simplest principles of wood finishing. To all such, and also for those who forget and need a work of this kind as a manual of reference, this little volume will prove useful.

SYNCHRONOUS AND OTHER MULTIPLE TELEGRAPHS. By Albert Cushing Crehore, Ph.D. New York: McGraw Publishing Company, 1905. 8vo.; pp. 124. Price, $2.

The subjects included in this book are divided into three parts. The first part is devoted to the general subject of methods of obtaining independent telegraph circuits by the use of direct and alternating currents on the same wire. The arrangements of circuits throughout the book, almost without exception, have been successfully operated either in the laboratory or under service conditions. Parts second and third relate to methods of obtaining circuits by means of the synchronous rotation of two bodies at distant points, the second part concerning the means of obtaining the synchronous rotation, and the third part the means by which the rotation may be utilized for securing independent telegraph circuits. The book is written to assist the reader to obtain a clear conception of the subject from a practical and experimental point of view.

PROCEEDINGS OF THE AMERICAN FOREST CONGRESS. American Forestry Association. Published for the Association by the H. M. Suter Publishing Company, Washington, D.C., 1905. 8vo.; pp. 474. Price, $1.25.

This book is a record of the meeting of the American Forest Congress, held in Washington, 1905, the object of the congress being to establish a broader understanding of the forest in its relation to the great industries depending upon it; to advance the conservative use of forest resources for both present and future needs of these industries, and to stimulate and unite all efforts to perpetuate the forest as a permanent resource of the nation. The volume is divided into seven parts, under the following heads: Forestry as a National Question; Importance of the Public Forest Lands to Irrigation; the Lumber Industry and the Forests; Importance of the Public Forest Lands to Grazing; Railroads in Relation to the Forest; Importance of Public Forest and Lands to Mining; National and State Forest Policy.

RAILWAY PROVIDENT INSTITUTIONS IN ENGLISH-SPEAKING COUNTRIES. By M. Riebenack. Philadelphia, Pa.: Pennsylvania Railroad Company, 1905. 8vo.; pp. 349.

This book, which is written by the Comptroller of the Pennsylvania Railroad Company, embodies the substance of two reports which the author submitted during the year 1904 to the International Commission of the International Railway Congress at Brussels for use at the session held at Washington May 3 to 13, 1905. It deals with most important economic conditions, and gives a mass of detail relative to insurance and relief provisions, hospital service, saving funds, co-operative capital stock purchasing schemes, Y. M. C. A. railway branches, literary study, etc. The book is a highly commendable one, and must have been a most difficult one to compile.

STEAM BOILERS: THEIR HISTORY AND DEVELOPMENT. By H. H. Powles, A.M.I.C.E., M.I.M.E. London: Archibald Constable & Co., Ltd. Philadelphia: J. B. Lippincott Company, 1905. 4to.; pp. 336, 15 plates. Price, $6.50.

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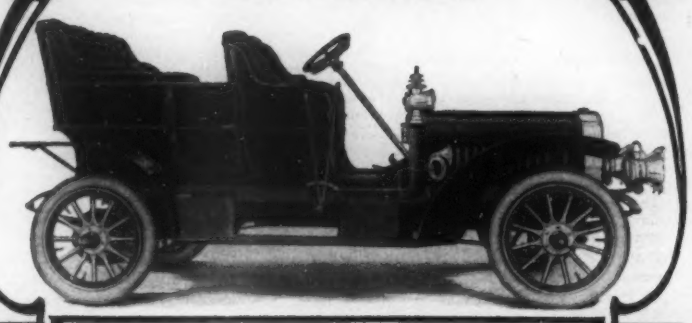

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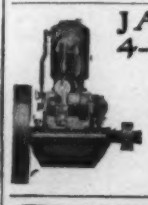

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THE COMMERCIAL TRAVELLER IN SOUTH AMERICA. By Frank Wiborg. New York: McClure, Phillips & Co., 1905. 12mo.; pp. 159. Price, $1.

This book gives the experiences and impressions of an American business man on a trip through Panama, Ecuador, Chili, Peru, the Argentine Republic, and Brazil. The author met many business men in these countries, and had favorable opportunities to find out why so little of the South American trade comes to the United States instead of to foreign countries. The book is concisely written, and will doubtless convey to our manufacturers considerable information beneficial to them. It is illustrated by a number of half-tone plates and a map showing the route taken by the author.

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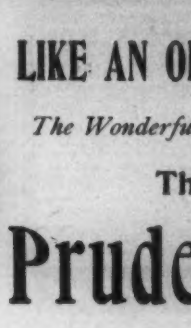

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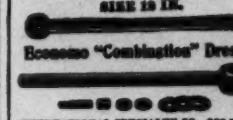

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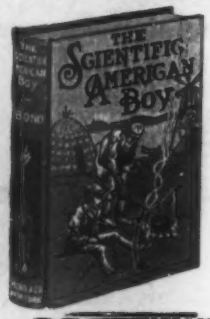

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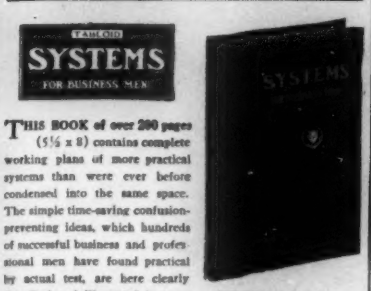

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